PB81-109340

Final-Environmental Impact Statement
Northglenn Water Management Program
City of Northglenn, Colorado

(U.S.) Environmental Protection Agency
Denver, CO

27 Jun 80

U.S. Department of Commerce
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NTIS

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA-908/5-5-79-002B

2.

3. RECIPIENT'S ACCESSION NO.
PB81 109340

4. TITLE AND SUBTITLE
Final Environmental Impact Statement
Northglenn Water Management Program
City of Northglenn, Colorado

5. REPORT DATE
June 27, 1980

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
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10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado

13. TYPE OF REPORT AND PERIOD COVERED
Final

14. SPONSORING AGENC CODE

15. SUPPLEMENTARY NOTES
Environmental Appraisal and Negative Declaration dated September 29, 1978, issued by EPA. Draft Environmental Impact Statement dated January 11, 1980 also issued by EPA.

16. ABSTRACT

This is a final Environmental Impact Statement (EIS) for proposed construction of facilities to provide water supply, wastewater treatment and agriculture reuse of sewage effluent for the City of Northglenn, Colorado. Under an exchange agreement with the Farmers Reservoir and Irrigation Company, approximately 5,000 acre-feet annually will be diverted for Northglenn's municipal use, treated, augmented from other sources, stored, and then returned for irrigation purposes.

The U.S. Environmental Protection Agency (EPA), Region VIII, Denver, under the authority of Section 201 of the Federal Water Pollution Control Act Amendments of 1972, is authorized to grant 75 and up to 85 percent matching funds for construction costs of designated wastewater treatment facilities.

The recommended action is to construct an 8 mile interceptor, aerated lagoon and a storage reservoir. Implementation of the exchange program negates the pending water condemnation actions that are in progress.

The appendix includes responses by EPA to comments recieved on the draft EIS, analysis of the alternative systems and cost estimates.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Wastewater Reclamation Sewage Irrigation Agricultural Reuse Water Pollution Flow Augmentation Plan Alternative Wastewater Treatment Technology Environmental Impact Statement	Denver Regional EIS for Wastewater Facilities and the Clean Water Program Denver Metro Sewage Farmers Reservoir and Irrigation Company	

18. DISTRIBUTION STATEMENT
Release Unlimited

19. SECURITY CLASS *(This Report)*

20. SECURITY CLASS *(This page)*

21. NO. OF PAGES

22. PRICE

PB81-109340

United States
Environmental Protection
Agency

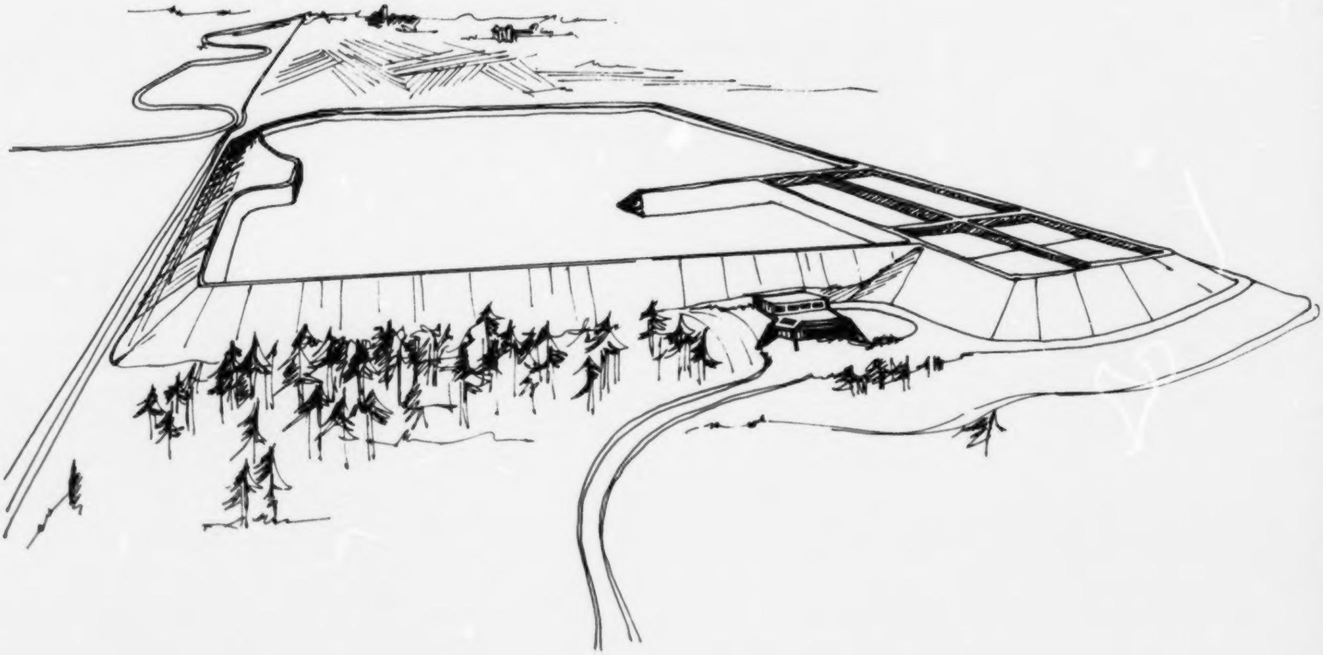
Region 8
1860 Lincoln Street
Denver, Colorado 80295

EPA 908/5-79-002B
June, 1980

EPA

Environmental Impact Statement

Final



Northglenn Water Management Program
City of Northglenn, Colorado

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*A society which is clamouring for choice,
which is filled with many articulate groups,
each urging its own brand of salvation, its own
variety of economic philosophy, will give each
new generation no peace until all have chosen
or gone under, unable to bear the conditions
of choice.*

Margaret Mead
Coming of Age in Samoa (1928)

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FINAL ENVIRONMENTAL IMPACT STATEMENT
NORTHGLENN WATER MANAGEMENT PROGRAM
CITY OF NORTHGLENN, COLORADO

Prepared by

U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

Approved by:
Roger L. Williams
Regional Administrator

Date: June 27, 1980

ACKNOWLEDGEMENTS

Because of the magnitude of the effort required to produce this environmental impact statement, it is an impossible task to acknowledge all of the people and agencies who contributed to the final product. A heart-felt thanks is extended to the individuals who have contributed and assisted in the completion of this monumental effort. A special thanks is offered to all of the secretaries without whose patience and long hours the project could not have been competed.

DISCLAIMER

This report has been reviewed by the EPA, Region VIII, Water Division and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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SUMMARY SHEET

FINAL ENVIRONMENTAL IMPACT STATEMENT

NORTHGLENN WATER MANAGEMENT PROGRAM
CITY OF NORTHGLENN, COLORADO

Prepared by the U.S. Environmental Protection Agency, Rocky Mountain Prairie Region, Region VIII, Denver, Colorado, with assistance from Engineering Science, Inc. and Tipton and Kalmbach, Inc., consulting firms from Denver, Colorado.

A. Type of Action: ( ) Draft EIS
(X) Final EIS

B. Brief Description of the Proposal

The Region VIII Administrator of the U.S. Environmental Protection Agency (EPA) intends to approve Federal matching funds for wastewater treatment facilities for the City of Northglenn, Colorado, through Title II of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), as amended in the Clean Water Act of 1977 (PL 95-217). Eligibility requirements and procedures necessary to qualify for a grant are set forth in 40 CFR, Part 35, Construction Grants for Wastewater Treatment Works. The Federal share shall be 75 percent of the total cost found to be eligible, with a portion of the facility being eligible for 85 percent Federal Assistance as "innovative or alternative wastewater treatment processes and techniques" referred to in Section 201(g)(5) of PL 95-217.

The purpose of this environmental impact statement is to present an evaluation of the environmental impacts of a plan submitted by Northglenn proposing to construct a multiple-purpose water resource project that includes a drinking water supply, wastewater collection and treatment system, an urban stormwater runoff collection system and an agricultural reuse program.

EPA issued an environmental appraisal/negative declaration on September 29, 1978 which analyzed the Northglenn Plan but left unanswered critical questions on the impacts to agriculture and public health. On January 11, 1980, EPA issued the draft EIS which analyzed these and other issues. EPA has decided to include in the final EIS additional analysis of water supply alternatives, operational alternatives, and other potential sites for the proposed facility.

C. Lead Agency, Project Officer Contact and Address

The U.S. Environmental Protection Agency is the lead agency in a joint effort with the State of Colorado and the City of Northglenn, Colorado, to approve plans, necessary permits, and finance or award grants in order to implement this proposal. Mr. Weston Wilson, U.S. Environmental Protection Agency, Region VIII is the designated project officer.

Requests for free copies of this document should be addressed to:

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Region VIII
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Denver, Colorado 80295

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D. Abstract of the Proposed Action

Northglenn has entered into a water exchange agreement with the Farmers Reservoir and Irrigation Company (FRICO) that allows Northglenn to borrow from FRICO up to 7,785 acre-feet per year of water stored in Standley Reservoir for municipal use. Northglenn is committed to return 110 percent of the water borrowed for municipal use to FRICO for agricultural use following wastewater treatment. In order to satisfy their pay back requirements of 110 percent, Northglenn proposes to construct a year-round storage reservoir in Weld County adjacent to their proposed wastewater treatment facility. The Plan requires the development of a means of replacing the water borrowed by the City plus 10 percent. This augmentation plan for the water pay back includes a proposal to collect and treat urban stormwater, plans to acquire sufficient surface and shallow groundwater supplies from the South Platte River and proposals to develop deep nontributary groundwater. Additional surface water supplies have been acquired through the purchase of agricultural water rights.

E. Date filed with EPA and listed in the Federal Register:

June 27, 1980

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Northglenn Water Management Program
City of Northglenn, Colorado

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CHAPTER 1

SUMMARY AND EPA DECISION

The intellect of man is forced to
  choose
Perfection of the life, or of
  the work...
      William B. Yeats
      The Choice (1933)

CHAPTER 1

SUMMARY AND EPA DECISION

INTRODUCTION

Title II of the 1977 Clean Water Act established a program to provide Federal assistance in the development and implementation of wastewater treatment management plans and the construction of publically owned treatment works. Federal financing of wastewater treatment works is implemented in three steps: Step I, facilities plans, Step II, preparation of construction drawings and specifications, and Step III, construction of treatment works.

Northglenn funded Step I and Step II plans without Federal assistance. In September 1977, Northglenn presented copies of their draft facility plan to EPA. The Plan was revised in November 1977 and again in March 1979. The State of Colorado Water Quality Control Division, in March 1978, submitted to EPA certification for Northglenn's funding. In accordance with regulation, EPA cannot award a grant until it has approved a facility plan for the proposed project and performed an analysis of the environmental impacts of the project under the National Environmental Policy Act. EPA issued an environmental appraisal/negative declaration on September 29, 1978 which analyzed the current plan but left unanswered critical questions on the impact to agriculture and public health. Subsequently, Northglenn modified its plan to include purchase of agriculture rights from the South Platte River following denial by the State Engineer of permits for nontributary deep wells. On January 11, 1980, EPA issued the draft EIS analyzing the environmental impacts of the Northglenn Plan.

DESCRIPTION OF THE PLAN

The City of Northglenn, Colorado is proposing to construct a multiple-purpose water resource project that consists of a drinking water supply, wastewater collection and treatment system, an urban stormwater runoff collection system and an agricultural reuse program. This integrated approach to water resource management is predicated on the following factors:

1) Northglenn's need to provide an adequate source of water for its users through the year 2000.

2) Northglenn currently is provided a water supply from the City of Thornton, Colorado. This water supply has, in the past, experienced concentrations of nitrite that exceed recommended criteria of the National Drinking Water Interim Primary Standards.

3) The Farmers Reservoir and Irrigation Company (FRICO) can provide an adequate supply of acceptable quality water to Northglenn and has demonstrated a willingness to participate in the proposed plan.

Northglenn has entered into a water exchange agreement with FRICO that allows Northglenn to borrow from FRICO up to 7,785 acre-feet per year of water stored in Standley Reservoir for municipal use. Northglenn is committed to return 110 percent of the water borrowed for municipal use to FRICO for agricultural use. To satisfy their pay back requirement of 110 percent, Northglenn proposed to construct a year-round storage reservoir in Weld County adjacent to its proposed wastewater treatment facility. The Plan also requires the development of a means of replacing the water borrowed by the City plus 10 percent. This plan for the water pay back includes a proposal to collect and treat urban stormwater, plans to acquire sufficient surface and shallow groundwater supplies from the South Platte, and proposals to develop deep nontributary groundwater. Surface water supplies have been acquired through the purchase of agricultural water rights. As defined under the agreement between FRICO and Northglenn, FRICO is free from any obligation to provide water to Northglenn until all necessary collection, storage, treatment, and transmission facilities are constructed and Northglenn has secured a decree from the Water Court that they have sufficient water to satisfy its obligations.

Presently Northglenn's wastewater is conveyed by the Thornton system and treated at the Denver Metropolitan Sewer District No. 1 (Denver Metro). This service is provided by Thornton through individual contracts that will expire by 1988 with each property owner in Northglenn. Consequently, Northglenn has negotiated an agreement with Thornton whereby Northglenn's wastewater treatment will be provided by Northglenn. Northglenn's revised facility plan (1) makes the following recommendations for wastewater transport, treatment, and disposal:

- Collection System - In accordance with the agreement reached with Thornton, Northglenn will make improvements to the existing collection system to redirect the wastewater flows to the new Northglenn facility. These improvements include sealing off several lines and connecting them to a new interceptor which will convey the wastewater from the City of Northglenn to the proposed treatment site.

- Conveyance System - An interceptor is needed to convey wastes from Northglenn and small Thornton enclaves within the service area. The proposed Northglenn Force Main (46,900 feet) would carry sewage and augmentation water eight miles north of the City to the proposed plant site.

- Wastewater Treatment - The Facility Plan recommends an aerated, three cell lagoon system for treatment prior to storage and discharge.

- Storage and Disposal - The Facility Plan recommends a 4362 acre-foot reservoir (Bull Canal Reservoir) to be constructed in Weld County to provide for winter storage of the effluent. The treatment and storage sites are located adjacent to the Bull Canal, approximately 1 1/2 miles northeast of the intersection of Interstate Highway 25 and Colorado State Highway 7 in Weld County, Colorado. During the irrigation season, FRICO has the right to call for release of water stored in the reservoir. Consequently, the discharge rate will fluctuate based on the calls made for water from the reservoir. Chlorination of the effluent will occur just prior to discharge from the storage reservoir to the Bull Canal irrigation ditch.

- Sludge Disposal - The Facility Plan recommends that sludge be removed and injected in the surrounding agricultural land.

Description of Options

As the Northglenn proposal includes an exchange of raw water for treated sewage water, EPA has determined that it is necessary to evaluate other water supply options as well as wastewater treatment alternatives. Within the framework of the Plan four options dealing with water supply have been identified by Northglenn and EPA. Each of the first three options assumes that wastewater and urban runoff are conveyed and treated at the Weld County treatment site.

- Option 1 - Northglenn obtains South Platte surface water rights and does not obtain any additional nontributary groundwater beyond their existing decrees.

- Option 2 - Northglenn is awarded 650 acre-feet per year of nontributary groundwater, thereby reducing the amount of FRICO borrowed water.

- Option 3 - Northglenn is awarded 2300 acre-feet per year of nontributary groundwater further reducing the amount of FRICO borrowed water.

- Option 4 - An alternative to these plans is for Northglenn to acquire its future water supply requirements from FRICO by condemnation or purchase. Wastewater under this system would be conveyed to and treated at the Denver Metro plant with discharge to the South Platte River.

A more extensive discussion of the four options and other water supply alternatives are presented in Chapter 4. Additional water supply systems evaluated include water from : the Denver Water Board, the Windy Gap Project, the Colorado Big-Thompson system, a new transmountain diversion, and expansion of the City of Thornton's system.

Five problems have been identified by EPA as key issues of this proposal. These issues are:

- public health
- agricultural productivity
- protection of potential drinking water supplies
- direct impacts of the wastewater treatment facility
- elgibility for EPA funding

EPA DECISION

The Northglenn proposal integrates total water resource management and includes such positive environmental features as agricultural reuse of effluent, exchange of water with irrigators, urban runoff controls and water conservation. Therefore, EPA proposes to approve the Northglenn proposal and to make a grant offer, with conditions, in the amount of $6,948,000.

This proposed decision is based on an analysis of the following factors:

1) additional public health control measures beyond those originally proposed in the plan are required and will be implemented by Northglenn; however the proposal in the draft EIS to prevent the sale of raw edible crops will not be required at this time;

2) the project includes certain benefits to agriculture as compared to the situation if water condemnation litigation had proven successful;

3) the Northglenn water rights applications, including change of water rights and the augmentation plan, are a logical approach to preventing injury to other vested water rights. There are a number of legal issues to be resolved by the Water Court and some changes to the water plan as filed are likely;

4) there are no significant direct adverse environmental effects of the proposal other than a potential odor problem at the treatment site and in the canal system;

5) assuming the Bull Canal is currently suitable as a domestic raw water source, if the proposal is implemented Bull Canal will no longer be suitable as a source of domestic raw water, since municipal effluent will on occasion comprise the entire flow in the Bull Canal. EPA concludes that since the Canal is not presently used for a domestic water supply, nor has there been any formal request to designate the Canal for domestic water supply, there is no need to protect the Canal for water supply;

6) the proposed wastewater system and agricultural reuse system is eligible for a grant providing partial funding as a multiple-purpose project using alternative technology as defined under the Clean Water Act;

7) additional analysis of site alternatives indicates there is no other site that is more environmentally acceptable. Results of the water supply analysis indicate other options are more costly while west slope sources will have less impact upon agriculture. An analysis of the treatment plant design indicates there is potential for exceeding the suspended solids limit due to algal growth which could be reduced through various control measures.

Further detailed explanation of the analysis of these factors follows:

Need for Additional Public Health Control Measures

Based upon review of the medical literature, and EPA and Colorado policies, EPA concludes that additional measures to further protect public health are necessary. The following three measures will be included as NPDES permit requirements:

1. Chlorination prior to discharge to further reduce the concentration of fecal coliform bacteria to 200 fecal coliform organisms per 100 milliliters (ml).

   A permit criterion of 1000/100 ml was considered sufficient for agricultural use where some dilution of the effluent would occur. Northglenn has agreed to meet a criterion of 200/100 ml for the discharge into Bull Canal.

2. Prevention of agriculture tailwater runoff into the Towns of Frederick and Firestone.

   Present agricultural practices combined with a lack of proper stormwater drainage allows runoff to flow through these communities. Northglenn will be required to intercept and control these flows in order to further reduce public contact with tailwater runoff (treated sewage effluent).

3. Complete disinfection of Dacono's nonpotable irrigation system.

   The Town of Dacono operates a nonpotable water system used for lawn and garden irrigation. The source of this water is Bull Canal which will, on occasion, consist entirely of treated wastewater effluent from Northglenn. In order to minimize the potential for disease transmission in this situation, Northglenn is required to disinfect or replace this source of nonpotable water.

Based upon additional analysis and consultation with the Colorado Department of Health, EPA concludes it will not be necessary at this time to require the prevention of sale of raw edible crops grown with Northglenn effluent. The draft EIS contained the following proposed grant condition:

> In order to receive a grant from EPA, Northglenn will have to agree to a plan to prevent the public sale or distribution of raw edible food crops irrigated with effluent from the Northglenn plant. Northglenn will assist farmers in marketing the crops to buyers who will process the crops or Northglenn will otherwise compensate the farmers for economic losses to the extent of actually purchasing the vegetables if no other satisfactory solution can be found. This condition is necessary in order to minimize the possibility of disease transmission through ingestion of contaminated vegetables. Northglenn will also issue and reissue an advisory that will inform farmers and discourage direct contact with the water and its use on private gardens.

EPA decided not to impose this condition as the analysis indicates the potential for pathogen survival through the system is very low due to reservoir detention time. Pathogen survival will be further reduced by chlorination of the effluent to meet the fecal coliform bacteria concentration of less than 200/100 ml. EPA concludes that public health risks under these conditions are not significant and that the public health in the reuse area will be adequately protected. However there is still some unknown risk that waterborne disease could be transmitted to humans who ingest raw edible vegetables irrigated with Northglenn effluent.

Currently EPA has not developed criteria or guidelines to determine treatment criteria for the use of sewage effluent on raw edible crops. During the next two years the agency will establish national guidelines for effluent criteria for unrestricted agricultural reuse. Upon completion of Agency policy in this regard and upon permit renewal, Northglenn will be required to comply with these new guidelines.

If the Northglenn facility is capable of meeting such new requirements or through a cost-effective analysis it is determined that operational or design changes are necessary to meet these requirements, then compliance will be obtained. In the event that the proposed agency guidelines are unachievable or too costly to achieve for the Northglenn facility, the imposition of a ban on the sale of raw edible crops will be reconsidered by EPA. Alternatively Northglenn could consider purchase of the FRICO water with disposal upon land owned or controlled by Northglenn.

Regarding the possible irrigation of private gardens, Northglenn will develop an educational plan that will inform farmers of the problem and discourage direct contact with the water and its use on private gardens. In the event that raw edible vegetable crops are irrigated with Northglenn's wastewater, EPA recommends farmers locate process markets for the crops.

See Chapter 5 for a complete description of these and other permit conditions and grant conditions.

Benefits to Agricultural Productivity

EPA analyzed the Northglenn water exchange plan for possible adverse economic and water quality effects upon agriculture. As originally proposed, the exchange plan included deep wells as the entire source of make-up waters. With development of such a new water source there would not be an adverse effect upon agriculture because of this new supply. The nontributary well permits were denied by the State Engineer and this matter is on appeal by Northglenn in Water Court. Northglenn then purchased South Platte surface water, some of which is currently used for agriculture, so that their plan could be implemented without such deep nontributary wells. Under the latter scheme, it was unclear if indeed there would be any agricultural benefits to the proposal. EPA decided that further study of the possible economic impact upon agriculture was necessary.

The agricultural economic analysis has been revised based on comments received on the draft EIS. The results indicate that by utilizing South Platte irrigation water as make-up for the FRICO exchange a decrease in agricultural productivity of up to $370,000 during a year of normal precipitation could occur along the South Platte River. However, this is more than compensated by continued agricultural production in the FRICO system of $1,950,000 in a similar year. Compared to either direct purchase or successful condemnation of the FRICO water supply, the proposed Northglenn exchange plan is beneficial to the agricultural community. Further, EPA concludes that properly managed, the benefit of the nutrient values in the sewage effluent will be a net asset which will enhance agriculture production in the area at reduced costs.

Under the Colorado Constitution which recognizes domestic preference, the condemnation proceedings against the FRICO water supply would likely be successful. Therefore, EPA supports the proposed exchange as being consistent with EPA policy to protect environmentally significant agricultural lands. (Chapters 3 and 4 provide further analysis.)

There are also possible adverse impacts to agriculture with respect to the changes in water quality created by the return of treated sewage effluent to the Bull Canal. Possible adverse effects include:

- reduction in sugar beet purity
- reduction in barley starch content

EPA concludes, based on comments from affected parties, that proper management, such as reduction of nitrogen fertilizer applications and correct scheduling of sewage effluent and Standley Lake releases, such problems are minor and should not affect crop production adversely.

Protection of Vested Water Rights

Northglenn must receive approval of the Water Court for a plan of augmentation in order to implement its proposal. In addition, Northglenn has purchased various water rights and intends to transfer such water. This shift in usage of the water in the overappropriated South Platte system must comply with Colorado's Water Law and receive approval by the State Water Court.

EPA concludes, based upon expert opinion, that 1) other complex plans with similar principles have been approved by the Water Court and this plan can be administered by the State Engineer; 2) the amount of water obtained from surface sources is reasonable based on historic ditch diversions and stream depletions; 3) the exchange plan will sufficiently protect FRICO shareholders; 4) through the Water Court process, out-of-priority diversions will be properly augmented; 5) the water rights to be used for augmentation are sufficiently senior for that purpose; 6) South Platte water users will be compensated for additional ditch losses; and 7) the Water Court will ensure that South Platte water users will be protected.

In analyzing the water rights and augmentation plans of the Northglenn project, a number of legal issues have been identified by EPA.

These legal issues will be resolved through the judicial process. EPA concludes that some changes to the water plans as filed are likely but the probable effect of any subsequent changes during the court process will likely be limited to requirements for additional water for augmenting purposes.

Direct Effects of the Proposal

EPA's conclusion as to the significance and impacts of direct adverse impacts is:

- Loss of tax base - The projected loss of $8,500 annually to Weld County and $300 annually to Adams County is a small decrease in net tax revenues to the two counties. No mitigation for this tax loss is recommended.
- Effect on Adjacent Land Values - A decrease in adjacent residential values up to five percent is possible with no change in farmland values.
- Groundwater pollution - The proposed clay liner of the reservoir and lagoon system will minimize any change in groundwater quality. Additional construction measures will be required by EPA and the Corps of Engineers to properly seal an inactive fault if present. No adverse impact upon groundwater is predicted.
- Odor problems - Under "worst case" conditions which include the unlikely combination of minimal atmospheric mixing and malfunction of the aeration system, the Colorado State Standard for odor could potentially be violated. Noticeable increases in odor could result.
- Reservoir Dam Safety - The design standards meet those recommended by the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers and have been approved by the Colorado State Engineer. No unusual risks are apparent.
- Aesthetics - The storage reservoir embankment will be revegetated and will have a low profile. Therefore, it should not adversely affect the aesthetics of the area.

(See Chapter 4 for additional analysis of these effects and other indirect effects.)

Protection for Potential Drinking Water Supplies is Not Necessary

The Bull Canal is not currently used for a domestic water supply and there has not been any petition to the State to designate this source for domestic use. Based on very limited data, it does appear the Bull Canal is currently suitable for a domestic raw water supply. The Town of Frederick indicated to EPA they intended to use water from the Bull Canal to augment their present surface supplies. The Town of Ft. Lupton has informed EPA of its intention to use Sand Hill Reservoir which receives some flow from Bull Canal as their future domestic water supply source.

The use of municipal effluent for a domestic source is not advisable because current treatment technology is unsuitable to treat such a source. In addition the concentration of nitrates in the Canal would adversely affect such plans since the concentration will exceed the National Drinking Water Standard of 10 mg/l. Water containing such high concentrations of nitrates is not economically suited as a domestic source. EPA recognizes that this change in water quality potentially represents a resource lost. EPA concludes that: 1) Bull Canal discharges to Sand Hill Reservoir are insignificant to the total inflow and, therefore, this proposal should not adversely affect Ft. Lupton's intended use of this source and 2) the Town of Frederick should seek an alternative water supply source.

The Proposal Qualifies for EPA Funding

EPA is presently in the process of developing a method for funding multiple-purpose projects which involve innovative and alternative technology in order to apply the incentives provided by the 1977 Clean Water Act Amendments. EPA determined at the time of the draft EIS that such projects are eligible for grant awards based on a formula of 115 percent of the ratio of the present worth cost of the most cost-effective single-purpose option, to the present worth cost of the multiple-purpose project. This formula calculates the fraction of the multiple-purpose project costs which are eligible for EPA funding. Portions of a multiple-purpose project which involve innovative or alternative technology are eligible for an 85 percent grant rather than the normal 75 percent grant. Agricultural reuse of effluent is defined in the Act as an alternative technology. The total grant amount is therefore determined by multiplying the fraction of the multiple-purpose project costs that are eligible times 85 percent for those items necessary for agricultural reuse and 75 percent for all other wastewater elements.

On March 20, 1980, EPA revised the options for funding such projects and the above procedure is no longer a funding option. This change is subsequent to Northglenn's application however, and therefore does not change the procedure as outlined.

For EPA to participate in the funding of a multiple-purpose project, the following rules apply. The Northglenn proposal meets these requirements:

1. The cost of the multiple-purpose project must not exceed the sum of the costs of the most cost-effective single-purpose options which accomplish the same purposes. (The Northglenn proposal combines wastewater treatment with agricultural reuse less expensively than two single purpose projects providing similar functions.)

2. The primary and secondary environmental effects are assessed in accordance with the NEPA review procedures. (As a result of this review under NEPA, EPA concludes that there are no significant net adverse environmental impacts and that net environmental benefits will result from this project.)

3. The pollution control purpose of the proposed project must be necessary to meet an enforceable requirement of the Act. (Additional costs associated with wastewater treatment are necessary for Northglenn during the 20 year planning period to meet enforceable requirements of the Act as defined in Denver Metro's discharge permit. These costs include the need to expand conveyance facilities and to expand and upgrade the Denver Metro Plant.)

4. There is no purchase of existing facilities with federal funds. (Northglenn's purchase of existing water distribution and collection systems has been eliminated from grant eligibility.)

5. The project meets the definition of treatment works, and the works are publicly owned. (The wastewater treatment project will be publicly owned.)

6. The project is consistent with the adopted and approved water quality management plan. (The Northglenn proposal is in compliance with the Denver Regional Council of Governments (DRCOG) Clean Water Plan. Adoption of an Intergovernmental Agreement with Weld County as required by EPA as a prerequisite to final grant payment will mean the project is also in compliance with the Larimer-Weld Council of Governments Clean Water Plan.)

7. The applicant must demonstrate a commitment that effluent will be applied to irrigated productive agricultural land for the design life of the project. (Northglenn has committed to a contingency plan where they will maintain sufficient land to reuse all water generated by the treatment plant for agricultural irrigation for the design life of the plant.)

Results of Additional Analysis

Based on comments received on the draft EIS, EPA expanded the analysis of the final EIS to include an investigation of other sites, other sources of water supply, and operational changes that may be necessary to meet permit requirements.

Three other sites in Adams County were identified as having suitable locations, soils, and remoteness from residential communities. While these sites are acceptable environmentally there is no apparent environmental advantage of selecting another site. Selection of an Adams County site would eliminate the need to develop an Intergovernmental Agreement with Weld County which remains a requirement yet to be accomplished.

Alternative water supply sources investigated included Denver Water Board (raw water and complete services), Colorado Big Thompson delivery, Windy Gap Project, and Northglenn's own west slope diversion. These sources are more costly than the proposed system and present administrative problems. The option of the City of Thornton expanding its sources in order to supply Northglenn is evaluated in this EIS but details could not be produced at this time since Thornton is still in the planning stages and has yet to define a preferred water supply source.

There is a difference among experts as to the likelihood of effluent from the facility meeting the suspended solids limit as specified in the permit. EPA's analysis of the feasibility of the proposed system indicates there is substantial likelihood that the proposed process will not limit carbon, thereby limiting algal growth. Acceptable operational controls to reduce algal growth include selective discharge (controlling the depth of discharge) and the use of introduced fish to consume algae. EPA does not recommend the use of copper sulphate to control algae since there is a chance that concentrations of copper could be released which would be deleterious to crop production.

CHAPTER 2

PURPOSE AND NEED

To every thing there is a season, and
a time to every purpose under the heaven.
The Bible
Ecclesiastes 3:1

CHAPTER 2

PURPOSE AND NEED

The City of Northglenn is located in a rapidly growing area north of Denver, Colorado. Northglenn is largely developed and surrounded by other incorporated communities. The 1976 population for Northglenn was 32,000 people in 9,500 residential units. There are 7,777 connections to the water system within the City to serve commercial, industrial, public, and residential users. The future population of Northglenn is limited to the existing available area of the incorporated City. Northglenn is a "land locked" community and once its ultimate population is achieved cannot expand to accept more growth. Northglenn's maximum growth is estimated to be 42,500 people. The annual growth rate is expected to be 3.1 percent. Northglenn will achieve its maximum growth before 1990. Because Northglenn's population is not expected to increase above 42,500 this population estimate is projected to be stable through the year 2000.

Until recently, the City of Thornton owned the water transmission and sewage collection systems in Northglenn. Thornton was responsible for operation and maintenance, billing of customers, construction of new lines and all other functions related to the total water and sewerage system.

Future water supply requirements of Northglenn have been estimated for a year of average precipitation and a dry year based on an expected population of 42,500 people. Based on this design population, the average and dry year water requirements of Northglenn are 6,840 acre-feet and 7,340 acre-feet of water, respectively.

The raw water quality at Thornton's Columbine Water Treatment Plant during periods in 1977 and 1978 had nitrite concentrations that exceeded the recommended limit of 1.0 mg/1(1). Northglenn's stated position has been that the City of Thornton could not provide an acceptable water, either in terms of quantity or quality and proceeded with the development of its water resource management plan. Thornton corrected the nitrite problems in 1978 by using break point chlorination (2) and currently is providing Northglenn a water supply of adequate quality and quantity. Thornton also indicates that they are currently developing water resources outside of the Denver metropolitan area to supplement their existing water supplies. The current position of Thornton is that they can provide an adequate water supply for themselves and Northglenn (3).

The need to acquire additional water supplies for future growth in Thornton, Westminster, and Northglenn resulted in several events which began in 1963. These actions are presented chronologically below:

- 1963 - Westminister entered into agreement with FRICO for use and storage of water in Standley Lake.

- 1973 - Thornton files condemnation proceedings against individual FRICO farmers.

- 1973 - Westminster files condemnation proceedings against FRICO farmers.

- 1976 - Northglenn enters into an exchange agreement with FRICO.

- 1979 (May) - Northglenn and Thornton enter into severance agreement of water and sewer services.

- 1979 (June) - Northglenn, Thornton, Westminster and FRICO enter into a four-way agreement which establishes an approach to cooperative planning for solving water supply problems, and facilitates the withdrawal of all condemnation suits against FRICO farmers.

By obtaining water from FRICO, Northglenn has assured itself water of adequate quality and a dependable water supply source for the future. The City has also obtained utility independence through the purchase of its water and sewer systems. In the process of entering into agreements to insure its future water supply, Northglenn made the commitment to return 110 percent of the water borrowed from FRICO. To achieve this water balance in the FRICO-Standley Lake Division, Northglenn intends to return its treated wastewater as part of its commitment to FRICO. As required by the September 2, 1976 agreement between Northglenn and FRICO, Northglenn must "collect the water (after municipal use), treat it in accordance with FRICO's specifications, store it and transmit it back to the FRICO irrigation network for delivery to FRICO stockholders". (4)

The agreements previously discussed are vital steps toward full implementation of Northglenn's current water resource management plan. Equally important steps such as Water Court approval of the Plan of Augmentation remain to be taken before the plan is fully implemented. If all obstacles are not overcome, then Northglenn will have to modify its current plan or use another approach to secure a safe, dependable source of water. Failure to implement the current plan would also affect the water supply plans of Thornton and Westminster, possibly resulting in these cities refiling condemnation proceedings against FRICO. The success of those proceedings could force Northglenn to secure other sources of irrigation water, nontributary groundwater, tributary groundwater, or combinations thereof. The environmental consequences of such a chain of events cannot be fully determined, and may be of lesser or greater magnitude than those resulting from the full implementation of Northglenn's current resource plan.

In effect Northglenn's proposed wastewater treatment facility is a function of the water supply and exchange program. In order to implement the exchange, control of wastewater treatment and discharge is essential.

CHAPTER 3

ANALYSIS OF ALTERNATIVES

"Mere parsimony is not economy.
...Expense, and great expense,
may be an essential part of
true economy."
Edmund Burke
Letter to a Noble Lord (1796)

CHAPTER 3

ANALYSIS OF ALTERNATIVES

INTRODUCTION

The basis of Northglenn's proposed project is to implement the FRICO Exchange Contract (May 1979) and the Severance Agreement (June 1979) under which the City would borrow water from agricultural interests, so that Northglenn's water supply needs can be met; and to replace the amount borrowed plus a ten percent bonus with treated domestic wastewater and water from other surface and subsurface supplies to which the City has rights. Within the context of Northglenn's project EPA has evaluated several options and alternatives for water supply and wastewater treatment. Northglenn has three options to meet its water supply requirements in combination with its exchange program and wastewater treatment plan. EPA has also evaluated wastewater treatment at the Denver Metro facility with several water supply options.

THE PROPOSED PROJECT

Northglenn has entered into a water exchange agreement with FRICO that allows Northglenn to borrow up to 7,785 acre-feet per year of water stored in Standley Reservoir for municipal use. Northglenn is committed to return 110 percent of the water borrowed for municipal use to FRICO for agricultural use following wastewater treatment. In order to satisfy their pay back requirements of 110 percent, Northglenn proposes to construct a year-round storage reservoir in Weld County adjacent to their proposed wastewater treatment facility. The plan requires the development of a means of replacing the water borrowed by the City plus 10 percent. This augmentation plan for the water pay back includes a proposal to collect and treat urban stormwater, plans to acquire sufficient surface and shallow groundwater supplies from the South Platte River and proposals to develop deep nontributary groundwater. Additional surface water supplies have been acquired through the purchase of agricultural water rights. In addition to Northglenn's proposed project EPA has considered various water management options and alternative sites for treatment and storage facilities.

Water Management Options

Northglenn's basic water supply program involves borrowing water from FRICO, which will be used along with water it owns, to meet its municipal water requirement. To evaluate the effects of Northglenn's plan, several options were selected for analysis. These options are schematically represented on Figures 3-1 through 3-4 (oversized - back of report). The options include:

1. No deep well supply other than Arapahoe Well No. 7.
2. A deep well supply equal to 650 acre-feet per year.

3. A deep well supply equal to 2300 acre-feet per year.

4. Acquisition of water required for municipal purposes from FRICO with treatment at Denver Metro. Discharge will be to the South Platte River.

Shown in Figures 3-1 through 3-4 are estimates of the annual yield or water requirement at various points throughout the FRICO-Standley Lake system. Details of the water budget for each of the options are shown in Table 3-1. The options were analyzed on the basis of depletion and yield studies provided by the consultants for the City of Northglenn and independently reviewed by an EPA consultant.

Under terms of the agreement between Northglenn and FRICO, replacement water is required to replace the municipal use loss and to provide for the ten percent bonus to FRICO. Replacement water will be diverted from Grange Hall Creek or the tributary well field. Both will have essentially the same overall depletion effect on the South Platte system as water will be taken out of priority and augmentation is required to protect other appropriators. Northglenn proposes that water will normally be taken first from Grange Hall Creek as pumping costs are less. The tributary well field will be used to supplement diversions from Grange Hall Creek.

To provide augmentation rights, Northglenn has purchased land and water rights in FRICO and along Clear Creek and the South Platte River. This water will be used when out-of-priority diversions from Grange Hall Creek or the South Platte tributary well field are made. When this occurs some lands will be taken out of production.

As discussed previously, Northglenn has filed application for nontributary groundwater beneath the City. It is their intention that this water will form a part of the City's raw water supply as illustrated in Figures 3-2 and 3-3. The amount of nontributary groundwater used will reduce the amount of water borrowed from FRICO which reduces the amount of water to be returned. Because it is nontributary Northglenn will not have to provide augmentation rights for this water.

Discussed in the following paragraphs are each of the options.

Option 1

Illustrated in Figure 3-1 are the water requirements and augmentation amounts required under Option 1. Under this option, the only nontributary groundwater included is that already approved by the State Engineer for Arapahoe Well No. 7. The total yield of surface water rights owned by Northglenn and intended to be used for the City's raw water supply system in a dry year is 1398 acre-feet, and in a year of average water availability, 2638 acre-feet. Arapahoe Well No. 7 yields 5 acre-feet per year in both dry and average years. During a dry year, the municipal water requirement is 7340 acre-feet and Northglenn will need to borrow a total of 5937 acre-feet from FRICO. Similarly, in an average year with a requirement of 6840 acre-feet a borrow of 4197 acre-feet will be needed.

TABLE 3-1

NORTHGLENN'S WATER BUDGET

1988 Conditions
(All values in Acre-feet)

	CONDITION							
	Option 1 Without Deep Wells		Option 2 650 af Deep Wells		Option 3 2300 af Deep Wells		Option 4 Return to Metro	
	Dry	Avg	Dry	Avg	Dry	Avg	Dry	Avg
Treated Water Requirements								
Household and Commercial	4140	4140	4140	4140	4140	4140	4140	4140
Irrigation (lawns and parks)	3200	2700	3200	2700	3200	2700	3200	2700
Total Water Required	7340	6840	7340	6840	7340	6840	7340	6840
Raw Water Sources								
Farmers Highline	69	137	69	137	69	137	69	137
Standley Lake Shares	1074	1504	1074	1504	1074	1504	1074	1504
Church Ditch	135	389	135	389	135	389	135	389
Berthoud Pass Ditch	120	608	120	608	120	608	120	608
Arapahoe Well No. 7	5	5	5	5	5	5	5	5
Proposed Deep Wells	0	0	645	645	2295	2295	0	0
FRICO Owned Water	5937	4197	5292	3552	3642	1902	5937(3)	4197(3)
Total Water Supplies	7340	6840	7340	6840	7340	6840	7340	6840
FRICO Exchange								
Net Amount Rec'd from FRICO	5937	4197	5292	3552	3642	1902	0	0
10% Bonus (500 AF min)	594	500	529	500	500	500	0	0
Reservoir Evaporation	316	236	316	236	316	236	0	0
Total Payback Requirement	6847	4933	6137	4288	4458	2638	0	0
Replacement/Wastewater Return								
Sewage - Northglenn	4016	4016	4016	4016	4016	4016	4016	4016
Sewage - Thornton Enclave[1]	885	885	885	885	885	885	885	885
Sewer Line Infiltration	300	300	300	300	300	300	300	300
Storm Runoff-Grange Hall Crk	1200	0	936	0	0	0	0	0
Tributary well Field	446	0	0	0	0	0	0	0
Total Water Available	6847	5201	6137	5201	5201	5201	5201	5201
Excess Physical Supply[2] (Total Available - Payback Requirement)	0	268	0	913	743	2563	To Metro Sewer for Treatment and release to South Platte River	
Diversions to be Augmented								
Grange Hall Creek	1200	0	936	0	0	0	To Metro Sewer for treatment and release to South Platte River	
Tributary Well Field	446	0	0	0	0	0		
Total Augmentation Requirements	1646	0	936	0	0	0		
Augmentation Rights Available	1985	2136	1985	2136	1985	2136		
Excess Water Rights to Meet Flow Requirements	339	2136	1049	2136	1985	2136		

(1) An enclave of Thornton will be connected to the Northglenn system.

(2) Excess water available in the system without augmenting which can be used for irrigation of Northglenn owned FRICO land.

(3) Water obtained from FRICO by purchase or condemnation of additional shares.

The primary reason dry year water requirements for a city are greater than an average year is because of the need for more lawn watering and other uses outside the home. The domestic and commercial water demand and wastewater flow is essentially constant. The total amount of wastewater estimated for all options is 5201 acre-feet. This includes wastewater from an enclave of Thornton and sewer system infiltration.

Under this option, in a dry year Northglenn will be required to return to FRICO 6531 acre-feet of water, including the bonus. The total replacement water requirement is 316 acre-feet greater because of reservoir evaporation loss. The amount of replacement water for an average year is 4933 acre-feet including 236 acre-feet to cover reservoir evaporation loss.

For Option 1, diversions to be augmented are 1646 acre-feet (1200 acre-feet from Grange Hall Creek and 446 acre-feet from the tributary well field) in the dry year. No out-of-priority diversions are required in an average year. As shown in Table 3-1 the augmentation rights available are 1985 acre-feet in the dry year and 2136 acre-feet in an average year.

For all of the options, the numbers presented in Figures 3-1 through 3-4 and Table 3-1 are based on the current Northglenn proposals and the augmentation plan submitted to the Water Court. The final augmentation plan approved by the Court may be different. In the event of rulings by the Court adversely affecting the amount of water claimed by Northglenn, the amount of augmenting rights available may not be adequate and additional rights may have to be acquired.

Option 2

The schematic representation of Option 2 is shown in Figure 3-2. This option includes a total of 650 acre-feet of nontributary groundwater as an inflow to the water system both in dry and average years. The amount of borrow required from FRICO is 5292 acre-feet for a dry year and 3552 acre-feet for an average year. The total payback requirement including reservoir evaporation is 6137 acre-feet in a dry year and 4288 acre-feet in an average year. The amount of water required to be augmented is 936 acre-feet in the dry year; no augmentation is required in an average year. Augmentation requirements are less in this option because of the use of nontributary well water that does not need augmentation.

Option 3

Option 3 is similar to Option 2 except that a total of 2300 acre-feet nontributary groundwater is available. This option is illustrated in Figure 3-3. In this option the amount of borrow from FRICO is 3642 acre-feet in the dry year and 1902 acre-feet in an average year.

Under this option, the deep well supply reduces the amount of borrow from FRICO so that the wastewater return is more than adequate to meet both dry year and average year payback requirements and no augmentation is required. The amount of excess wastewater flow over the required payback is 743 acre-feet in the dry year and 2563 acre-feet in an average year.

Option 4

Option 4 is an alternative to the exchange plan with FRICO. The amount of water required to meet Northglenn's municipal requirements in excess of the Arapahoe Well No. 7 and the yield of the City's owned water is acquired either by purchase or condemnation from FRICO. Instead of returning wastewater for agricultural purposes, it is treated at Denver's Metro Plant and released to the South Platte River. As there are no out-of-priority diversions in this option, augmenting rights are not required. The water supply to Northglenn is covered by owned water rights and water rights acquired from the Standley Lake system. The depletion due to the municipal use is less than the historic agricultural depletion and therefore no other rights would be injured.

Under this option the 5201 acre-feet of wastewater that is returned to FRICO under Options 1 through 3 would be available in the South Platte.

Treatment Site Alternatives

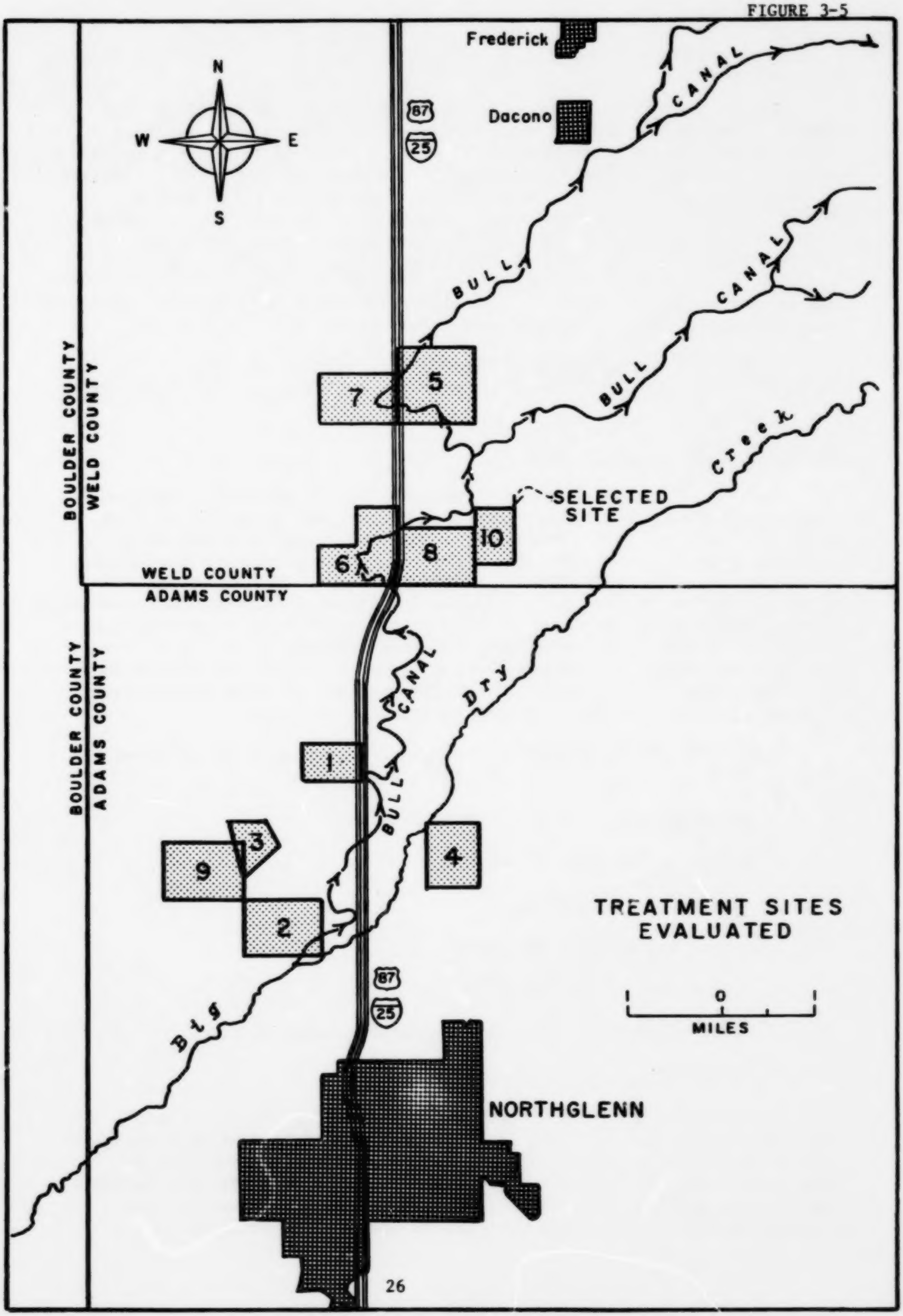
The Northglenn water resource management plan initially considered nine alternative sites for wastewater treatment and storage. At that time, the treatment and reservoir systems were larger than currently planned, because the project was sized to provide treatment and storage for wastewater from both Northglenn and Thornton. In addition, the reservoir was to be located on a natural drainage thus reducing reservoir construction requirements and costs. Thus, larger land requirements were necessary. However, Thornton has withdrawn from participating in the project, and other changes have been made which effectively reduce land and other site requirements. A detailed analysis of site alternatives for the proposed plan is presented in Appendix F.

Seven criteria were used by Northglenn to evaluate the alternative sites shown on Figure 3-5. These criteria included:

- compatibility with surrounding land use
- safety of reservoir design
- control of seepage losses
- underlying mineral resources
- operational flexibility
- consistency with approved wastewater management plans
- severability of system components

The complete analysis of each site is presented in Northglenn's Application for Site Approval. (1). However, the site analysis presents a bias toward the selected site, Site 10, because sites one through nine were evaluated for both a larger and physically different treatment and storage facility as originally proposed. Site ten was the only site evaluated for the revised treatment and storage facility.

FIGURE 3-5


Frederick
Dacono
N
W
E
S
87
25
BULL CANAL
BULL CANAL
BULL CANAL
Dry Creek
Big
BOULDER COUNTY
WELD COUNTY
WELD COUNTY
ADAMS COUNTY
BOULDER COUNTY
ADAMS COUNTY
SELECTED SITE
1
2
3
4
5
6
7
8
9
10
TREATMENT SITES EVALUATED
0
MILES
NORTHGLENN

In view of the above, EPA determined it was necessary to conduct an alternative site analysis for a wastewater treatment and storage system identical to the currently proposed Northglenn facility. EPA recognizes that Northglenn has expended a considerable amount of time and money investigating and designing for Site 10. An additional alternative site analysis was performed to evaluate three additional sites for treatment and storage of Northglenn's wastewater. This analysis is presented in Appendix F.

The purpose of this analysis was to determine if another site is environmentally preferred or whether Northglenn's proposed treatment site is environmentally acceptable when compared to other sites.

This analysis did not develop information to the level of detail currently available on the proposed site for which final designs have been completed. The analysis considered all four sites (including Site 10) from an overview perspective, using existing data. The selection criteria for the three additional sites were:

- site would require no more than three residences to be relocated
- the site is not located in a natural drainage

Based on these criteria the three sites located on Figure 3-6 and designated as A, B, and C were considered.

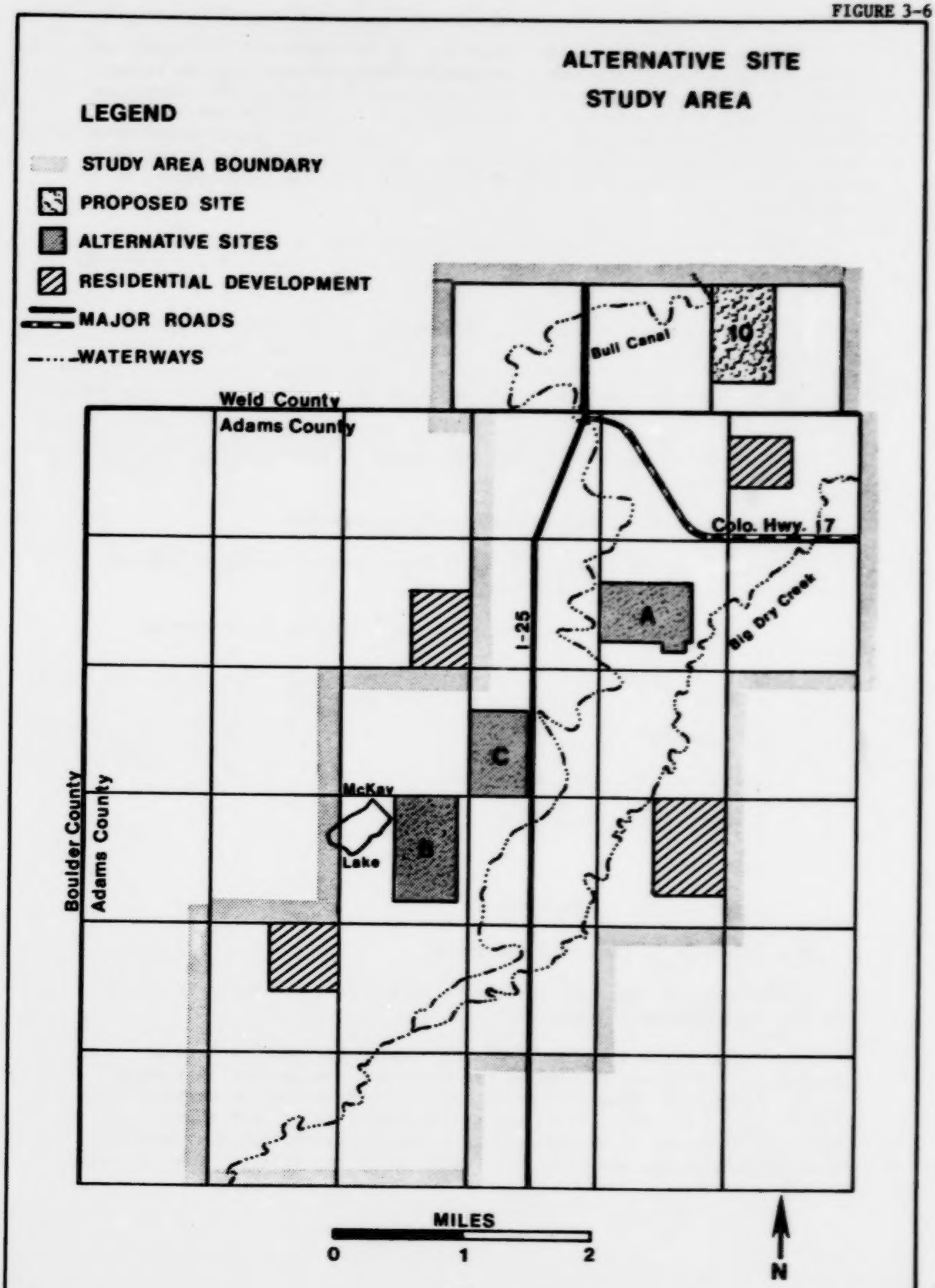
All four sites are evaluated using the following environmental criteria:

- geology
- groundwater
- soils and construction geology
- topography and flooding
- land use
- proximity to the Bull Canal
- consistency with land use plans

Additionally, the cost of relocating the proposed facility to one of the new sites was considered.

All four sites are environmentally suited for construction of Northglenn's proposed wastewater treatment and storage facility based on the evaluation summarized in Table 3-2. Differences do exist between Sites A, B, C and 10 based on the evaluation criteria, but these differences are believed to be insignificant and can be mitigated by construction techniques and monitoring. Generally, no one site has the advantage in all criteria.

FIGURE 3-6



ALTERNATIVE SITE STUDY AREA

LEGEND
STUDY AREA BOUNDARY
PROPOSED SITE
ALTERNATIVE SITES
RESIDENTIAL DEVELOPMENT
MAJOR ROADS
WATERWAYS
Bull Canal
10
Weld County
Adams County
Colo. Hwy. 17
I-25
A
Big Dry Creek
C
McKay
Lake
B
Boulder County
Adams County
MILES
0
1
2
N

TABLE 3-2 ENVIRONMENTAL EVALUATION MATRIX OF ALTERNATIVE TREATMENT AND STORAGE SITES

CRITERION	SITE A	SITE B	SITE C	SITE 10
Geology				
Mineral Resources	No sand or gravel resources, possible oil, gas or coal	No sand or gravel resources, possible oil, gas or coal	No sand or gravel resources, possible oil gas or coal	No sand, gravel or recoverable coal resources, possible oil or gas.
Faults	No active or potentially active faults	No active or potentially active faults	No active or potentially active faults	No active or potentially active faults
Subsidence	Probably not of concern: South of Boulder - Weld Coal Field	Probably not of concern South of Boulder - Weld Coal Field	Probably not of concern: South of Boulder - Weld Coal Field	Probably not of concern: South of Boulder - Weld Coal Field
Soils				
Permeability	Low perm., 0.06 - 20 in/hr	Low perm., 0.06- 20 in/hr	Low perm., 0.06 - 20 in/hr	Low perm., 0.06 - 20 in/hr
Suitability for Construction	Med. to low shear strength Mod. to high shrink-swell pot.	Med. to low shear strength Mod. to high shrink-swell pot.	Med. to low shear strength Mod. to severe shrink-swell pot.	Low shear strength, Mod. shrink-swell pot.
Prime Agriculture Land	Yes - if irrigated	Yes - if irrigated	Yes - if irrigated	Yes - if irrigated
Topography				
Slope	East half 3-5% slope to east West half 0-3% slope to east Total elevation change 60 ft.	0-3% slope toward southeast Total elevation change 50 ft.	3-9% slope around two knolls near center of site; total elevation change 55 ft.	3-5% slope around knoll in southeast corner; 0-3% slope to northwest corner, total elevation change 60 ft.
Flooding Potential	Slight	Moderate	Moderate	Slight
Groundwater				
Depth	Perched: 6-12 ft. Deep: 70 - 300 ft.	Perched: 8-15 ft. Deep: 25 - 120 ft.	Perched: 8-12 ft. Deep: 25 - 70 ft.	Perched: 6-10 ft. Deep: 28 - 30 ft.
Number of Wells Onsite	2(1 municipal, 1 other uses)	2(1 domestic, 1 irrigation and stock)	0	0
Land Use				
Current	Agriculture	Agriculture	Agriculture	Agriculture
Zoning	A-3	A-3	A-3	Agricultural
No. of Residences	None on site; 20-30 within 1/2 mile	None on site; 40 - 80 within 1/2 mile	None on site; 30 - 40 within 1/2 mile	None on site; 20 - 30 within 1/2 mile
Proximity to Bull Canal	200 ft.	900 ft.	300 ft.	50 ft.
Cost 1/	$30,247,900	$30,326,600	$30,110,400	$30,242,300

1/ Does not include costs of delaying project.

It is recognized that time and money have been committed to the development of Site 10 and that relocation from this site would result in some loss. However, based on this initial analysis, credits gained due to a shorter force main and land sales could partially offset the expenditures to date. If only direct costs (excluding costs associated with project delay) and environmental aspects are considered, all four sites are equally suited for the proposed project.

ALTERNATIVES TO THE PROPOSED PROJECT

Northglenn has taken steps to secure its future water supply and proposes to implement an exchange agreement with FRICO. This water exchange is an integral part of Northglenn's wastewater treatment facility plan. EPA has undertaken an analysis of alternative water supply sources, and their environmental and economic impacts in association with wastewater treatment alternatives, to compare the proposed project impacts to feasible alternatives.

Water Supply Alternatives

Municipalities within the Denver Metropolitan Area have several options available for a water supply source. The basic options consist of developing a water resource on the West Slope or East Slope of the continental divide or a combination of both. Water from either the West Slope or East Slope can be obtained by the following means:

- Development of new appropriations
- Acquire existing water rights
- Participation in existing water development projects

A detailed analysis of these alternatives is contained in Appendix D. Another water supply alternative to those presented in this Chapter was offered by several opponents. This alternative is discussed in Appendix M.

West Slope Water

New Appropriations. New appropriations require the creation of new water rights on the West Slope. However, new appropriations in the Colorado River Basin are not expected to be easily obtained and not likely to provide a dependable water supply. West Slope water availability has been diminishing as a result of growth of the West Slope, planned transmountain diversions, and perfection of existing rights. Further, energy development demands are expected to use much of Colorado's share of the water allocated under the Colorado River Compact. Lower basin states are expected to exercise their rights under the Colorado River Compact and Upper Basin Compact. Prior to the year 2000, it is expected that this new demand will curtail the use of direct flow and storage water rights junior to 1970 and may even affect rights junior to 1960.

Acquiring Existing Water Rights. Acquiring existing water rights involves the purchase of water rights that are now physically in existence. Water rights could be purchased from agricultural users or from an existing transmountain diverter. A West Slope agricultural water right is expected to yield from 0.75 to 1.25 acre feet per acre. Based on these figures, Northglenn would require agricultural water purchases that would come from 6,000 to 10,000 acres.

Participation In Existing Water Projects. Projects for which Northglenn may be eligible for participation in with another municipality include:

- Aurora's Homestake Project
- Colorado Big Thompson Project
- Windy Gap Project

Participation in the City of Aurora's Homestake Project is questionable at this time. The estimated yield from this project ranges from 10,500 acre-feet in an average year to 3,300 acre-feet in a dry year. It is unclear if Aurora has water supplies in excess of its own requirements, and construction is not projected to be completed until 1988.

Existing stipulations prohibit the use of Colorado Big Thompson (CBT) water outside the boundaries of the Northern Colorado Water Conservancy District (NCWCD). Northglenn is outside these boundaries and currently ineligible for CBT water. Northglenn could potentially be annexed into NCWCD. NCWCD is concerned with their ability to meet present water demand projections and past court petitions for water have been defeated on the basis of impairing the rights of present CBT water users. Furthermore, NCWCD's present water supplies have been allocated to existing users within the district. The extent of Northglenn's privileges with a new subdistrict would only be that of attempting to buy-out existing user's rights.

Windy Gap is a subdistrict of the NCWCD. Water resources to be developed by this subdistrict have been allocated. Upon admission to the subdistrict, Northglenn would have to purchase part of the water allotment from an existing participant. Currently, no excess water is available from any of the existing participants. Should Northglenn be able to acquire its required allotment of water, it is assumed that the water would be delivered and stored at Boulder Reservoir and pumped through a new pipeline to Northglenn for treatment. A 5300 acre-foot reservoir would be required to provide for the five month winter shutdown of Windy Gap.

Environmental Effects of Developing West Slope Water

Each of the West Slope water supply alternatives considered for Northglenn will result in an adverse environmental impact to Colorado's West Slope.

The most severe physical impact of transmountain diversions to the Colorado River basin has been associated with reduction in the flow of high quality water in the headwaters and the resultant increases in salinity in the lower reaches of the system. This would create economic impacts to the existing West Slope municipal, industrial, and agricultural users. Any new appropriation and transmountain diversions of Colorado River water will compound these impacts. If Northglenn were to acquire existing water rights, the associated impacts could potentially be less in terms of water quality, but would result in a reduction of irrigated agriculture on the West Slope.

Acquisition of new or existing water rights on the West Slope to support a water demand on the East Slope is also constrained economically and politically. In addition to the need to overcome engineering problems of conveyance the time in developing a water supply is extensive and institutional arrangements are difficult. The construction of the facilities needed to deliver the water to Northglenn would have minor impacts.

East Slope Water

New Appropriations. New appropriations would require new water rights from the South Platte River. Intense competition exists for any further allocation of the South Platte River and its tributaries. It is thought that the allocation of rights on the South Platte have been over extended. A flow of 5,000 cubic feet per second (cfs) in the South Platte River at the Denver gaging station is considered necessary to realistically satisfy the perfected direct flow water rights on the mainstream, even though the decreed water rights far exceed 5,000 cfs (2). Flows in excess of 5,000 cfs would represent surplus water available to a new appropriation. Flows in excess of 5,000 cfs were experienced for only ten years during the period 1896 to 1975. If the Narrows Reservoir is constructed and its conditional water right perfected, no surplus water upstream of Narrows would be available. Because of the unreliability of new appropriations in the South Platte River Basin, municipal water supplies would not be feasible and new reservoir storage development would largely be supported by independent water supplies or by existing decrees.

New appropriations of nontributary water from the deep underlying aquifer of the Denver Basin are available. Northglenn has applied for such deep well water rights to supply a portion of their water needs.

Acquiring Existing Water Rights. Acquiring existing water rights on the East Slope would involve the conversion of agricultural water. The market place and price of water rights on the East Slope have been changing drastically in recent years. Municipalities, because of their demands, are in competition for agricultural water rights and prices for such water are rapidly increasing. Municipalities have the right to condemn agricultural water as a last resort to obtaining needed supplies. The conversion of agricultural water rights to meet municipal demands is exerting pressures on agricultural water rights and threatening the present agricultural economy.

Participation in Existing Projects. The existing systems available for Northglenn to pursue as water supply options are: Denver Water Board, Thornton and FRICO exchange.

Denver Water Board (DWB) has indicated in the past that it would be interested in providing Northglenn's water supply, although recent reports indicate current supplies may not meet present water demands beyond 1998.

The Denver City Charter prohibits water service outside the City limits if there is not enough water for the inner city water requirements. Presently the DWB has adopted a policy of exercising caution in entering into new contracts for outside service and is limiting the number of annual taps for new service. The DWB has stated that it fully intends to scrutinize any additions to the service areas of its existing raw water customers, and contracts for the distribution of raw water supplies outside the service boundaries will be stopped.

If water service was available from Denver, either raw water service or treated water service could be considered as an available alternative.

Northglenn currently is receiving water from the City of Thornton and could continue. Future service would be subject to Thornton's agreement to provide water and Thornton having sufficient water resources to provide it. Thornton officials have indicated in the past they are capable and willing to provide an adequate quality and quantity of water to Northglenn in the future. (1). However, Thornton's current position is that they have taken steps to sever their systems and believe it is not feasible or appropriate for Thornton to reassess its water resource development plan at this late date. (See May 1, 1980 letter to EPA from Thornton. Appendix A.)

The present water supply sources for the City of Thornton come from water rights located in Upper Clear Creek, Lower Clear Creek, South Park and pumping alluvial groundwater from the South Platte River Basin under GASP. (GASP, or Groundwater Appropriators of the South Platte River Basin, Inc. is a non-profit organization of volunteer members formed to provide replacement water for tributary well pumping in the South Platte River Basin. GASP procures approximately 30,000 acre-feet of water each year from various sources, including the Colorado-Big Thompson Project and Union and McClellan Reservoirs. This water is turned over to the State to be released as necessary to replace water withdrawn from the South Platte system between Denver and the Nebraska state line. Currently a member of GASP is required to replace 5 percent of his total well diversion.)

Thornton currently has a dry year yield of water approaching 20,000 acre-feet per year which is adequate to supply Thornton's and Northglenn's current demand of about 14,000 acre-feet per year. Northglenn uses about 40 percent of the total or 5,600 acre-feet. Utilization of reservoir storage with Thornton's direct flow rights could increase the dry year yield from 4,000 to 6,000 acre-feet. Also, a proposed exchange with the Burlington Ditch could add another 7,000 acre-feet. Thornton estimates it will require 20,000 acre-feet per year by the year 2000 without providing service to Northglenn. Assuming reservoir storage and the Burlington exchange is ultimately incorporated into the Thornton's water supply system, Thornton would have a yield slightly over 30,000 acre-feet which would meet the combined requirements of Thornton and Northglenn for the year 2000. Thornton's ultimate need is estimated to be 45,000 acre-feet without Northglenn. These estimates are based on current projections by Thornton. Thornton is in the Water Court on a number of projects and in the process of finalizing other water supply sources. According to Thornton officials, planning for Thornton's water supply in the future consists of the following:

1. The City will continue with an active program of purchasing additional agricultural rights along Clear Creek.
2. Although Thornton does not currently own any rights on the West Slope, there is a possibility of a joint venture development of West Slope water in conjunction with other water users.
3. Thornton will continue to purchase agricultural rights in the South Park area.
4. The City has filed for new storage rights in South Park and has a storage exchange agreement with Aurora in Aurora's proposed Spinney Mountain Reservoir.
5. Thornton currently has an application pending with the Water Court to allow an exchange with the Burlington Ditch along the South Platte River.
6. The possible expansion of tributary wells under GASP is also an alternative for future supplies to the City.

Thornton is currently developing additional water resources for the City and has applications in Water Court on a number of various water rights. Studies and documentation concerning Thornton's present supply and future plans were not available for this analysis; however, a general overall discussion with City officials concerning this alternative has provided information for considering Thornton for Northglenn's water supply.

Environmental Effects of Developing East Slope Surface Water

The most severe environmental impact of developing East Slope water as a water supply source is a reduction in irrigated agriculture. This impact is most prevalent to agriculture along the South Platte River and areas adjacent to Metropolitan Denver. New appropriations of water would have the least effect on agricultural production. However, new surface water is not readily available. Furthermore, if the Water Court were to determine that new surface water required augmentation, it is probable that augmentation waters would come from agricultural uses.

It is possible that municipalities facing water shortages in the future will condemn extensive areas of agricultural land for water rights. Such action will damage an important part of Colorado's economy.

The alternative of Northglenn continuing to receive its water supply from Thornton as previously discussed must also be considered. Two options are considered under this alternative. In both options it is assumed that Northglenn's water rights are purchased by Thornton and incorporated into their water resources.

Under the Thornton option one assumes that all of Northglenn's currently owned water rights are purchased by Thornton. These rights include Clear Creek, FRICO, and South Platte consumptive uses but not the Northglenn-FRICO exchange agreement or nontributary groundwater. The total amount of water available from such a potential purchase is 3,400 acre-feet. The agricultural impact of purchase of these rights owned by Northglenn and currently in agricultural production is $600,000 in an average year. This option does not establish any agricultural impact of Thornton's water resource developments.

The second option assumes Northglenn's water rights consist of only Clear Creek, and FRICO but not South Platte, Northglenn-FRICO exchange, or nontributary groundwater. The Northglenn owned water currently in agricultural production is 1504 acre-feet in an average year. Transfer of this water to Thornton would result in a loss of $148,200 of agricultural productivity. To provide the additional water required by Northglenn it is assumed Thornton would, at a minimum, acquire 5,942 acre-feet from the South Park area. Utilizing storage in the South Park area, a firm yield of about 1.0 acre-foot per acre of consumptive use could be realized with the purchase of relatively senior South Park agricultural rights. The cost of 5,942 acre-feet may average $2,000 per acre-foot, or a total of $11.9 million. According to the Colorado Agricultural Statistics the predominate South Park crop is hay with a yield of less than 1.0 ton per acre. Assuming an average irrigated production of 1.0 ton per acre and a price of $60 per ton, the amount of reduced agriculture production in South Park is $360,000 based on 1979 figures. The total amount of agricultural production lost under this option is $508,200.

The environmental impacts of the Northglenn-FRICO exchange are presented in the agricultural productivity section of Chapter 4. See the comparison of the impact of Northglenn's water supply options on agricultural production in Table 4-5.

Wastewater Treatment Alternatives

Two wastewater treatment alternatives are identified for Northglenn. The two alternatives consist of: Northglenn's proposed three cell lagoons followed by reservoir storage and discharge to the Bull Canal, and treatment continued at Denver Metro.

Northglenn's proposed wastewater treatment facility is described previously in the Chapter. The proposed system is coupled with three water supply options. Treatment at Denver Metro could be compatible with all water supply alternatives with the exception of the FRICO exchange agreement.

WATER RESOURCE/WASTEWATER TREATMENT ALTERNATIVE COST ANALYSIS

A synthesis of water supply and wastewater treatment alternatives are identified for the City of Northglenn. The Windy Gap Project has the highest potential for participation by Northglenn of the West Slope alternatives considered. Feasible options for Northglenn's participation on the East Slope are limited to: Northglenn's proposed exchange with FRICO, Denver Water Board service, and Thornton. The combination of these final water supply alternatives and the associated wastewater treatment options which are analyzed on a cost basis are:

FRICO Water Supply

Three options of exchange agreements available. Northglenn treats wastewater and returns to FRICO.

Purchase of Water Rights. Denver Metro treats wastewater, South Platte discharge.

Windy Gap Water Supply

Northglenn Wastewater Treatment
Denver Metro Wastewater Treatment

Denver Water Board Water Supply

Denver Water Board Raw Water Contract
Northglenn Wastewater Treatment
Denver Metro Wastewater Treatment

Denver Water Board Full Service Contract
Northglenn Wastewater Treatment
Denver Metro Wastewater Treatment

Thornton Water Supply

Denver Metro Wastewater Treatment

Development of Costs

The evaluation of water resource/wastewater treatment options considers capital costs, operation and maintenance costs, and salvage value. Present worth and annual household costs have been calculated.

Costs for each of the alternatives were prepared following EPA guidelines. The basic assumptions followed for cost formulation are:

1. Construction costs are based on July, 1979 prices.
2. Operation and maintenance costs are based on January 1, 1980 prices.
3. Present worth calculations are based on a 20 year period and a 6-7/8 percentage rate of interest.
4. All systems are sized to serve the ultimate population of the service area (42,500 people).
5. All operation and maintenance costs are based on projected 1990 flow rates.
6. The present worth and equivalent annual costs are reduced by the salvage value of various system components in the year 2000.
7. Calculations of salvage values follow EPA cost-effectiveness guidelines.
8. An average household cost is based on average year water demands.

A summary of calculated cost estimates has been formulated in order to assess the alternatives and is presented in Table 3-3. A detailed discussion of the development of these costs is presented in Appendix J.

Thornton as a water supply option does not lend itself to a cost analysis. This is in part a consequence of the undefined character of where water would be developed. If Northglenn were to continue with water service from Thornton it could be assumed the water supply would come totally from currently undeveloped water resources, developed water resources, or some combination of both.

The analysis provides a basis for cost comparisons under a variety of alternatives. The least costly alternative for water supply and treatment are the options under the proposed exchange project. High operations and maintenance cost for the other alternatives indicate higher costs above those of the proposed plan.

Projected User Costs

The cost estimates are for comparison purposes, following EPA guidelines. The annual charges levied against each household would be different from the costs presented in Table 3-3 for the water supply options. Reasons for these differences include:

1. Other revenues such as tap fees and water leasing can actually reduce the system costs prior to ultimate development.
2. Financing of future bond expenditures is likely to be around 9 percent for 30 years if current market conditions prevail.
3. No provision has been made for the future inflation of construction, and operation and maintenance costs.
4. Some of the options considered are institutionally inveasible at this time. For instance, agricultural reuse under the Denver Water Board raw water and treated water options would be difficult under the Board's policy to retain dominion over the wastewater generated from its water supply contracts.

Presented in Table 3-4 are the estimated annual charges per average household and for a single family residence for the proposed project. These estimates include provisions for tap fee revenues, inflation through 1990 and short-term water leases.

Thornton Water Supply Costs

Theoretically, Northglenn could reconnect onto Thornton for water supply service. In order to conceptualize what the cost of this alternative may be, several assumptions must be made. It is currently unknown what costs would be incurred to renegotiate the severance agreement, what the future rates for connections, taps, and water resource development would be, and if current service charges for Northglenn would be

TABLE 3-3

COSTS OF ALTERNATIVE NORTHGLENN WATER SUPPLY/WASTEWATER TREATMENT SYSTEMS

	FRICO WATER SUPPLY		WINDY GAP WATER SUPPLY		DENVER WATER BOARD WATER SUPPLY			
					Raw Water Contract		Full Service Contract	
	FRICO Agricultural Reuse (proposed project)	Denver Metro Wastewater Treatment	North-glenn Wastewater Treatment	Denver Metro Wastewater Treatment	North-glenn Wastewater Treatment	Denver Metro Wastewater Treatment	North-glenn Wastewater Treatment	Denver Metro Wastewater Treatment
Capital ($)								
Water Supply	$ 36,268,000	$ 56,190,000	$ 61,136,000	$ 61,136,000	$ 51,834,000	$ 51,834,400	$ 54,843,000	$ 54,843,000
Replacement Water	7,400,000	0	0	0	0	0	0	0
Wastewater	17,272,000	15,037,000	17,272,000	15,037,000	17,272,000	15,037,000	17,272,000	15,037,000
Total	$ 60,940,000	$ 71,227,000	$ 78,408,000	$ 76,173,000	$ 69,106,000	$ 66,871,400	$ 72,115,000	$ 69,880,000
Operation & Maintenance ($/Yr.)								
Water Supply	$ 1,066,000	$ 1,066,000	$ 1,351,500	$ 1,351,500	$ 2,112,200	$ 2,112,200	$ 2,626,000	$ 2,626,000
Replacement Water	55,000	0	0	0	0	0	0	0
Wastewater	529,800	661,000	529,800	661,000	529,800	661,000	529,800	661,000
Total	$ 1,650,800	$ 1,727,000	$ 1,881,300	$ 2,012,500	$ 2,642,000	$ 2,773,200	$ 3,155,800	$ 3,287,000
Present Worth ($)								
Water Supply	$ 40,798,000	$ 52,798,000	$ 66,969,400	$ 66,969,400	$ 65,333,200	$ 65,333,000	$ 71,222,000	$ 71,222,000
Replacement Water	5,900,000	0	0	0	0	0	0	0
Wastewater	19,739,000	19,671,000	19,739,000	19,671,000	19,739,000	19,671,000	19,739,000	19,671,000
Total	$ 66,437,000	$ 72,469,000	$ 86,708,400	$ 86,640,400	$ 85,072,200	$ 85,004,000	$ 90,961,000	$ 90,893,000
Annual Average Household Cost ($/Yr.)								
Water Supply	230	305	369	369	360	360	393	393
Replacement Water	40	0	0	0	0	0	0	0
Wastewater	114	114	114	114	114	114	114	114
Total	384	419	483	483	474	474	507	507

TABLE 3-4

AVERAGE ANNUAL USER CHARGE
NORTHGLENN PROPOSED WATER MANAGEMENT PLAN

Year	All Households[a] $/yr	Single Family Household $/yr
1980	228	272
1981	315	375
1982	340	405
1983	367	437
1984	396	472
1985	428	510
1986	463	551
1987	463	551
1988	463	551
1989	463	551
1990	463	551

a. Average includes both single family and multi-family dwelling units.

different from other Thornton system users located outside the system. For purposes of this analysis four conditions have been developed. All conditions assume the following:

- current (1980) charges for connection, taps, and water resource development remain fixed in the future.
- all new taps and connections will be 3/4 inch. 683 new taps and connections will be necessary for the projected population growth.
- current operation and maintenance costs of the water distribution system will not change.
- costs associated with monthly user charges are not factored in to the analysis.

As it is not known what charges Thornton may assess Northglenn, four different conditions of cost assumptions have been made. Under Condition 1, it is assumed that the residents connected to the existing distribution system would not be charged connection or tap fees but would be charged for the water resources development fee. The 683 new taps and connections would be charged for connection and tap fees as well as water resource development. The money Northglenn has paid to Thornton to acquire the water distribution system (associated with the severence agreement - sunk cost) is assumed to be excluded.

Condition 2 assumes the same conditions as Condition 1 except the severence costs are assumed to be included.

Condition 3 assumes that all existing and future connections in Northglenn must pay the entire tap, connection and water resource charges to Thornton based on Thornton's present fee schedule. Maximum development is estimated to consist of a total of 8460 taps and connections of various sizes. Severence costs are assumed to be excluded.

Condition 4 assumes the same conditions as Condition 3 except the severence costs are included.

These costs are presented in Table 3-5. The conclusion is that total costs for a Thornton water supply option could vary from the least costly to the most costly alternative depending upon what conditions for financing would be required by Thornton.

TABLE 3-5

COST SUMMARY

THORNTON WATER SUPPLY CONDITIONS

	Condition 1	Condition 2	Condition 3	Condition 4
Total Capital Cost ($)	25,300,000	45,600,000	93,900,000	114,200,000
Operation & Maintenance ($) $280,000 x 10.492 (Present Worth Factor)[3]	2,940,000	2,940,000	2,940,000	2,940,000
Total Present Worth ($)	28,240,000	48,540,000	96,840,000	117,140,000
Annualized Cost ($)	2,690,000	4,630,000	9,230,000	11,160,000
Annual Average Household Cost ($) [4.]	182[1.]/735[2.]	343[1.]/896[2.]	760	917

1. Existing homes, no tap or connection charges.

2. New homes, tap and connection charges.

3. Present worth of operation and maintenance costs calculated at 7 1/8% for 20 years.

4. Assumes 3.5 people per household.

NO FEDERAL ACTION ALTERNATIVE

The "No Federal Action" alternative includes a refusal by EPA to make a grant to the City of Northglenn for wastewater treatment. Such a denial by EPA could be based on a finding of ineligibility under the Clean Water Act or significant unavoidable adverse environmental impacts. Northglenn's total water management program is expected to cost $67 million with $6.9 million eligible under EPA regulations. As only 10 percent of the captial costs and none of the annual costs are expected from the federal government, Northglenn has indicated to EPA that they will still proceed with the project in the absence of federal funds. Thus, it is possible that Northglenn will complete the water management program entirely with local funds should EPA deny or fail to make a grant.

The consequences of the "no Federal Action" alternative are then very similar to Northglenn's proposal except that those grant conditions required by EPA for additional public health protection or for other reasons need not be executed by Northglenn.

CHAPTER 4

SIGNIFICANT ENVIRONMENTAL ISSUES

An important scientific innovation rarely makes its way by gradually winning over and converting its opponents: it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out and that the growing generation is familiarized with the idea from the beginning.

Max Plank
The Philosophy of Physics (1936)

CHAPTER 4

SIGNIFICANT ENVIRONMENTAL ISSUES

This chapter of the EIS addresses the significant environmental issues associated with the proposed project. These issues have been identified through public involvement, the concerns of the parties and governmental agencies involved, and from the planning, research and analysis that has been performed. The following discussions summarize the investigations conducted regarding significant environmental issues.

PROPOSED TREATMENT PROCESS

There are innovative aspects of the proposed wastewater treatment process which pose certain potential risks including the possible public health hazards described in this Chapter. The following discussion summarizes a detailed evaluation which has been performed of the treatment process concepts, design and expected facility performance. The full report of this evaluation is reproduced as Appendix E to this EIS.

Treatment Concepts

The proposed treatment system consists of a parallel series of three aerated lagoons followed by a storage reservoir. Raw wastewater will enter the first lagoon and be subject to high aeration and mixing to essentially convert all the soluble BOD and a major part of the biodegradable solids into microbial cells. Average detention time in the first cell will be twenty-four hours, with essentially no settlement of solids.

Wastewaters will flow to the second cell where reduced aeration and limited mixing will take place maintaining the cell mass from the first cell. As cell mass continues to convert BOD to inert material, the heavier solids will settle out. The detention time in the second cell will be four days. It is possible during warm weather that a population of nitrifying bacteria, (slow-growing bacteria that convert ammonia to nitrates), may be established to a limited extent, but the major nitrification process would occur in the third cell where the detention time of nine days would be more conducive to the growth of nitrifying bacteria. The purpose of nitrification is to reduce the amount of carbon available as an algal nutrient in the final storage reservoir. Algal growth must be controlled so that the final reservoir effluent suspended solids concentration will meet discharge requirements. Excessive suspended solids could also result in a possible source of odors. Although some aeration will be provided, in the third cell its primary purpose will be to maintain aerobic conditions and to promote settling of suspended solids.

Pilot studies of the proposed treatment system were conducted from the end of June to November 10, 1978, to test the validity of the treatment concepts.

An analysis of the concepts, of the data base, and of the results from the pilot studies revealed several factors which should be considered in projecting future performance. These are:

- The data on wastewater characteristics used to develop treatment concepts and designs are very limited, and are limited to existing Northglenn wastewaters. If the proposed project is implemented,different sources of water supply, including storm water runoff, may result in changes to the wastewater characteristics.

- Wastewater other than Northglenn's was used in the pilot plant studies.

- Pilot studies were not conducted long enough to assess performance during cold weather.

- As expected, microbial activity during pilot studies decreased during lower temperature operation with consequent reductions in BOD removal. The implication is that there could be significant BOD carryover, including organic carbon, into the reservoir, affecting the capability of maintaining a carbon limiting system for algal control.

- It is doubtful that sufficient nitrification in the second and third cells could be maintained during cold weather operation.

Design Evaluation

A brief review of the final design has also been conducted. The conclusions are:

- The number and spacing of fixed aerators and amount of air supplied in each of the three cells is generally satisfactory. Adjustments in location or supplemental aeration over the side slopes of the first cell lagoon are suggested. Relocation of aerators away from the third cell lagoon effluent overflow point would prevent resuspension and carryover of settled solids in the third cell.

- The heat loss calculations for operation during cold weather appear to underestimate actual heat losses. Consequently, further reductions in BOD removal and nitrification are likely during cold weather operations.

- The annual energy requirements of the proposed conveyance and treatment system appear to be higher than the Denver Metro alternative.

The other aspects of the facility design and underlying design calculations appear reasonable and acceptable.

Facility Performance

It is anticipated that the effluent limitations that will be specified in the NPDES discharge permit for the Northglenn facility will be 30 mg/l suspended solids, 30 mg/l BOD_5, and 200 fecal coliforms per 100 ml all for thirty day averages. Based upon the analysis herein presented and reported in Appendix E, it is concluded that the proposed Northglenn wastewater treatment system:

1. will likely meet BOD_5 limits
2. will likely meet suspended solids limits during winter operation, but there is a high probability that effluent limits will be exceeded during summer months
3. effluent limits of 200 fecal coliforms per 100 ml will require chlorination of reservoir effluent. Due to lengthy detention times there is a very low risk of transmissions of waterborne diseases.
4. It is not probable that a carbon-limiting system can be maintained in the reservoir. Thus algal blooms are possible as is the case for almost any reservoir.

In view of the above, several mitigating measures were evaluated to determine if algal blooms could be controlled. The measures evaluated included the use of algicides, flocculants, biological controls such as algae-consuming fish, selective discharge and filtration. Algicides such as copper sulfate are not acceptable to EPA due to the potential release of copper concentrations toxic to crops. Flocculants settle the nutrients temporarily to the bottom, but the nutrients are still available for subsequent algal growth. Biological controls may successfully reduce algal concentrations without impact. If an exotic fish species is used, such as talapia, then screening will be necessary to prevent their release because release could interfere with native sport fishes. Selective discharge including depth and timing of effluent release is effective and environmentally benign. Northglenn will have to monitor suspended solids and only discharge if concentrations are less than the permit requirement of 30 mg/l. If the effluent quality is not suitable to meet the NPDES permit, control of algae will be necessary before discharge. Thus FRICO may be asked to temporarily not call on Bull Canal Reservoir until Northglenn has controlled any problem due to algal growth.

PUBLIC HEALTH

Potential health risks associated with uncontrolled use of wastewater conveyed through irrigation canals are:

- direct human contact with wastewater which has received little or no dilution

- human consumption of raw edible crops irrigated with wastewater

The specific risks within the Study Area are:

- public exposure/potential contact with effluent in the Bull Canal and lateral ditches

- contact by FRICO farmers with effluent through irrigation practices

- public exposure/contact with effluent at Dacono through their public irrigation system

- public exposure/contact with effluent as irrigation tailwater in the communities of Frederick and Firestone

- ingestion of raw food crops irrigated with effluent on FRICO farms

- raw edible food crops irrigated with effluent offered for public sale (none presently grown in FRICO-Standley Lake Division).

Coliform bacteria are the commonly used indicator organisms for assessing public health risks associated with waterborne disease. Fecal coliform, bacteria common to warm-blooded animals, are recognized as positive indicators of potential health risks. The potential for isolating a specific pathogen per unit volume in 100 percent effluent is significantly higher than when the same effluent has been volumetrically diluted. It is therefore apparent that with 100 percent effluent the potential for infection is greater than with a diluted effluent. The fecal coliform analysis however, does not differentiate specific pathogens.

During dry year conditions,flow in the Bull Canal may be entirely sewage effluent, thus increasing the public health risk. The State of Colorado provides minimal guidance on this problem in their water quality criteria and standards.

The draft water quality standards proposed by the State include a standard for agriculture for a fecal coliform limit of 1000 organisms per 100 milliliters (ml). The value of 1000 organisms per 100 ml is based on an ambient instream condition and is not based on a condition of 100 percent wastewater. In Colorado's final water quality standards the 1000 organisms/100 ml has been omitted for agriculture.

The State separates recreational waters into two classes. Class I recreation is primary contact and Class II is secondary contact. The Report of the Committee on Water Quality Criteria specifies that the primary contact (Class I) category includes such activities as wading and dabbling by children, swimming, diving, water skiing, and surfing; where there is a relatively high probability of ingesting small quantities of water and where there is contact with mucous membranes. Secondary contact (Class II) includes activities in which contact with the water is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal. These include such activities as boating and fishing.

The Class I recreational criterion is based on data which indicate a sharp increase in the frequency of detection of Salmonella when fecal coliform densities exceed 200 organisms per 100 ml in fresh water. Currently, this is one of the most acceptable relationships which have been developed between indicator organisms and waterborne pathogens. This relationship is based on an instream condition and not 100 percent effluent.

Public Health Risks and Irrigation with Northglenn Effluent

EPA believes that the reuse of wastewater, when out of the control of a municipality, should be under conditions that provide for the protection of public health during both agricultural uses and public exposure. A review of the medical and technical literature regarding such risks is presented in Appendix C.

In a dry year, irrigation water in the Bull Canal below the Northglenn discharge will during certain periods consist of 100 percent effluent with no dilution. It can be concluded from the literature review (in Appendix C) that public health risks associated with effluent reuse must be considered on a case-by-case basis. EPA, in its process design manual for Land Treatment of Municipal Wastewater endorses this approach by stating, "Safeguards must be established on a case-by-case basis so that the relative risk of disease transmission in each situation can be evaluated individually" (1).

Guidance for determining reasonable health safeguards for effluent irrigation systems in which public exposure is not controlled is provided from EPA and the Colorado Department of Health. EPA (2) recommends for areas where the public has access and exposure to the wastewater, that the fecal coliform limit should not exceed 200/100 ml. The Colorado Department of Health (3) guidelines for landscape irrigation, because direct contact with wastewater by the public is possible, also require that chlorination result in less than 200 fecal coliforms per 100 ml. The State guidelines also indicate crops grown under these conditions shall not be raw edible vegetables (3).

These values are not as conservative as the California Code or the World Health Organization criterion of 2.2/100 ml (total coliform) and 100/100 ml (total coliform), respectively for similar exposure situations. The Food and Drug Administration currently recommends that raw edible food crops not be irrigated with domestic wastewater irrespective of the degree of treatment.

Data on public health risks relative to irrigation with wastewater are conflicting and are reflected in the lack of uniform requirements or standards covering such use. The data on public health hazards associated with uncontrolled access/use of treated wastewater are virtually non-existent. EPA believes the proposed Colorado primary contact recreational bacteriologic standard of 200 fecal coliform organisms per 100 ml is a reasonable bacteriological criterion for discharge of the treated Northglenn wastewater to the FRICO system. This standard is compatible with unrestricted public access to the FRICO canal system (4). The proposed bacteriological discharge level of the Northglenn effluent (4,5) will provide a relatively high level of pathogen control, but the presence of some pathogenic organisms in the irrigation water can be expected. Therefore, EPA and the Colorado Department of Health in the NPDES permit have required that, prior to discharge, chlorination achieve a level of less than 200 fecal colonies per 100 milliliters.

Heavy Metals and Industrial Pretreatment Requirements

Heavy metals present in wastewater are generally concentrated in wastewater sludges. Major heavy metals of concern to the food chain include cadmium, copper, zinc, molybdenum, selenium, and lead. All of these are of sufficiently low concentrations in the natural soils and the projected wastewater effluent that they are not expected to produce an adverse impact. Soils with high clay content also protect against the availability of metals for plant uptake. For most toxic metals, reduced crop yields are experienced at lower levels than those that create health risks.

A likely source of heavy metals in the wastewater system will be from industrial discharges. A condition to obtaining construction grant funds is that the applicant implement a sewer use and pretreatment ordinance. Northglenn must have such an ordinance approved prior to the award of a construction grant for the new treatment facility. A portion of Thornton will also be served by Northglenn and this area will require a similar ordinance as required by the May 4, 1979, Northglenn-Thornton agreement (6).

The purpose of a sewer use ordinance is to prevent discharge of materials into sewer lines which would create a discharge violation or make treatment unreasonably costly. A list of these materials, critical concentrations, and treatment requirements will be delineated in the sewer ordinance.

Although the City of Northglenn is comprised largely of residential units, there are some commercial and industrial facilities which potentially may discharge harmful wastes. A list of dischargers in the Northglenn service area is given in Table 4-1. A review of these facilities in Northglenn indicates that car washes and laundries are the predominant potential sources of industrial waste. An evaluation of these wastes on a case-by-case basis is necessary to determine if pretreatment is warranted. The proposed EPA treatment and control technologies for such facilities are:

- Dissolved air floatation,
- Coagulation/Settling/Filtration,
- Water Recycling, or
- Polishing Filters - Multi-Media and Carbon

The Thornton areas served by Northglenn are indicated in Figure 4-1. A review of zoning ordinances indicates that the majority of these areas are classified as commercial and industrial, with minor sections classified as residential development. As in Northglenn, laundries are the major industrial dischargers in Thornton.

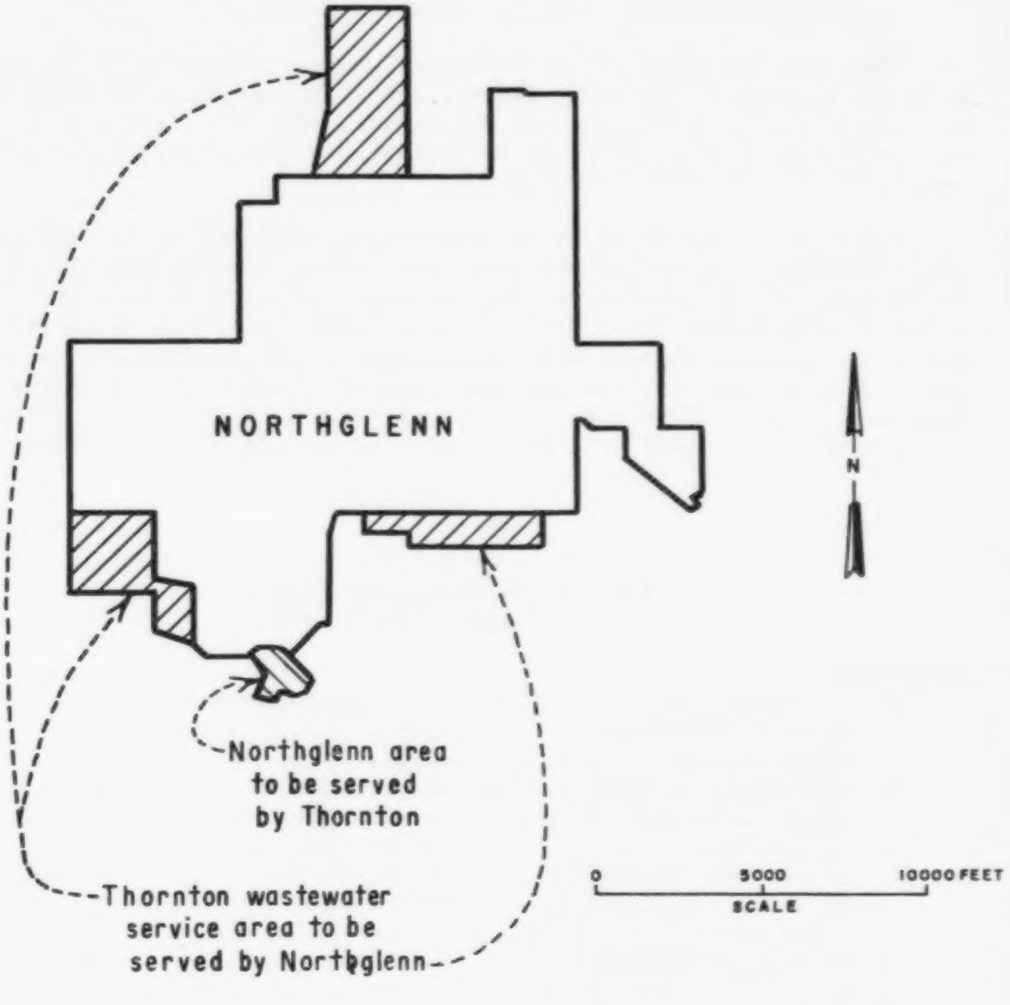
Based on review of existing and proposed development it is concluded that industrial wastes are and will be a very small component of the wastewater from the Northglenn service area. The wastewater from the potential industrial and commercial establishments should be evaluated but it is unlikely that it will significantly affect the operation of the treatment facility, the effluent quality, or adversely affect sludge disposal. EPA concludes that the expected heavy metal concentrations in the effluent and sludge will not present any significant health risk.

TABLE 4-1

POTENTIAL INDUSTRIAL DISCHARGERS IN NORTHGLENN SERVICE AREA

Discharger	Description
NORTHGLENN	
. Whistle Stop Exxon	Service Station w/car wash
. Huron Texaco	Service Station w/car wash
. Robinson's Standard	Service Station w/car wash
. North Washington Conoco	Service Station w/car wash
. Clean-o-mat	Laundromat
. Silver State Cleaners	Dry Cleaners
. Silver State Cleaners and Laundry	Dry Cleaners and laundromat
. Robo of Northglenn	Car wash
THORNTON	
. Triple A Coin Op	Laundromat
. Gigantic Cleaners	Laundromat

FIGURE 4-1


NORTHGLENN
N
Northglenn area to be served by Thornton
Thornton wastewater service area to be served by Northglenn
0
5000
10000 FEET
SCALE

THORNTON ENCLAVES TO BE SERVED BY NORTHGLENN

AGRICULTURAL ISSUES

EPA has established policy designed to help protect environmentally significant agricultural lands (7). The policy is to protect significant agricultural land from irreversible conversion to uses which result in its loss as an environmental or essential food production resource.

The Northglenn plan is designed to provide a benefit to agricultural productivity. All elements of the plan, water supply, wastewater treatment, and reuse, are closely integrated with agricultural practices of both the South Platte River and FRICO-Standley Lake Division.

It is a major goal of this document to determine if the proposed plan is consistent with EPA's agricultural policy. The determination of consistency will be based on a comparative review of changes in agricultural productivity in FRICO and the South Platte for the options evaluated. Also evaluated will be the effect upon agriculture of the comparative changes in irrigation water quality in the Bull Canal for the various options. See Appendix G for a detailed explanation of these issues.

The projected future water quality of the Bull Canal will exhibit an increase in nitrogen which will be beneficial to nitrogen-demanding crops. However, sugar beet and malt barley are nitrogen sensitive crops. Nitrogen uptake by sugar beets is approximately 80 pounds per acre, and the barley uptake is about 75 pounds per acre.

When nitrogen deliveries exceed nitrogen uptake demand of sugar beets, a reduction of the percent sucrose content and purity occurs. This reduces the marketability and/or market value of the crop. Great Western Sugar Company in its contract with growers specifies that after July 15 the growers are prohibited from further nitrogen application. This provision assures that sugar beets will meet specifications for effective sugar recovery. Great Western has indicated that with proper water management Northglenn's effluent will provide a nutrient benefit to crops.

Nitrogen uptake by barley affects the protein and starch content. Again, marketability is reduced and entire shipments may be rejected by the processor if excessive nitrogen applications have severely reduced the starch content.

Water Supply to Agriculture

Analysis of the Northglenn Water Management Plan has indicated a number of potential issues which could affect the operation of the plan and the amount of augmentation water ultimately required by the City.

Nontributary Groundwater

Nontributary groundwater (water that is not connected with the surface stream system) is available within the underlying aquifers of the City of Northglenn in the Arapahoe and Laramie-Fox Hills formations. Northglenn has one well, Arapahoe Well No. 7, completed into the Arapahoe formation which is estimated to yield a small supply of 5 acre-feet per year. Information provided by Northglenn's engineers, Wright Water Engineers, Inc., based on a report prepared by John Romero of the State Engineer's office indicates there is approximately 100,000 acre-feet of water in the Laramie-Fox Hills aquifer beneath the city limits of Northglenn and 130,000 acre-feet in the Arapahoe Formation available for appropriation. (8) This results in an estimated annual withdrawal rate of between 2100 and 2300 acre-feet per year. (One percent of the 230,000 acre-feet estimated to be available as deep nontributary groundwater.) The study generally encompassed a wide area and the amount of water actually available will be determined after the wells have been drilled.

There are a number of issues involved with nontributary groundwater as a source of supply. The primary issue relates to Northglenn's right to appropriate water beneath the City limits but under land not owned by the City without the consent of the property owner. Other issues involve questions of the amount of water actually available and whether the water is in fact nontributary. These issues are currently before the Water Court. The effect of any rulings which reduce the quantity of water available from the aquifers beneath the City for use by Northglenn will require more borrowed water from FRICO by Northglenn or the acquisition of other surface waters.

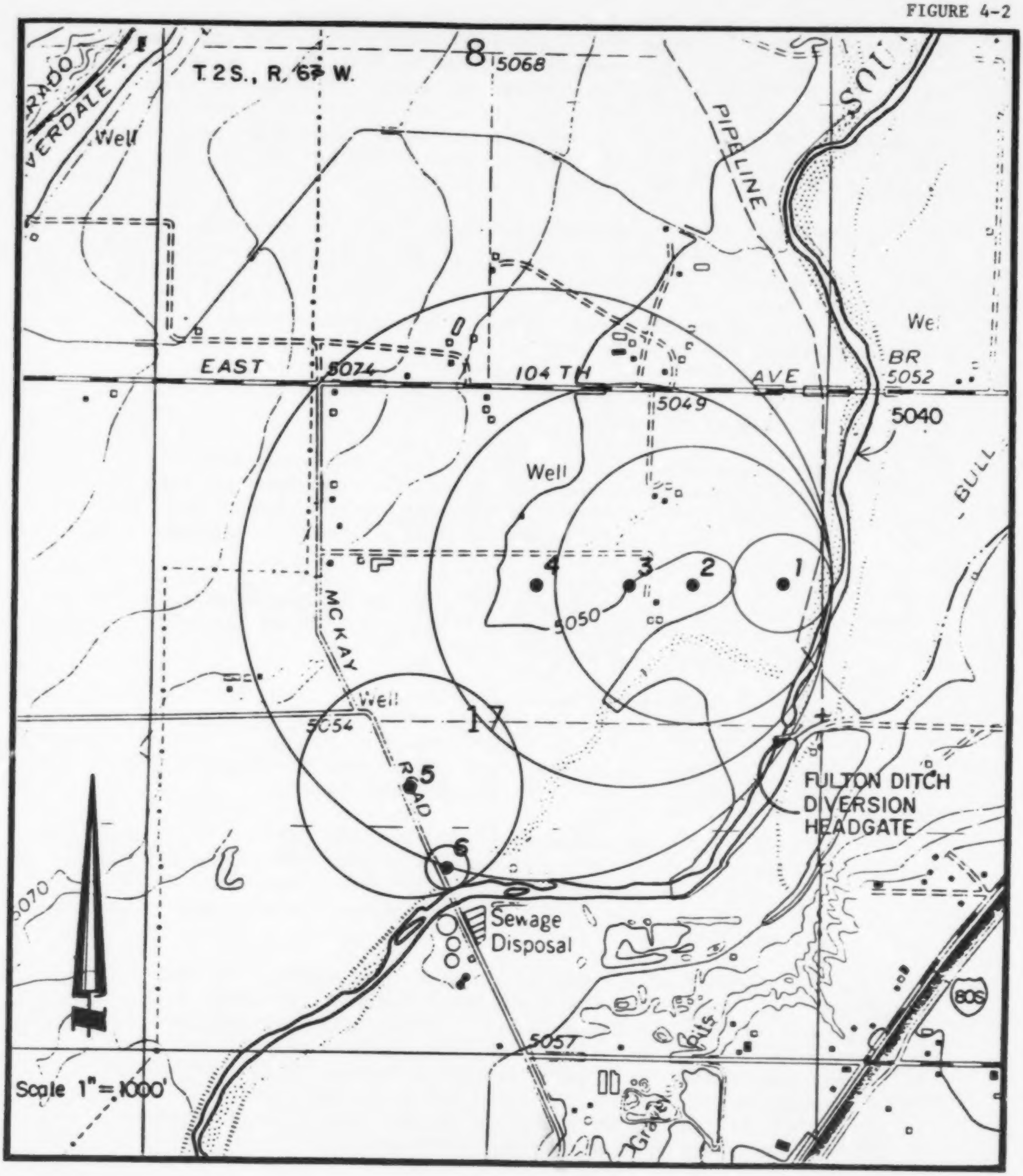
Tributary Groundwater

One option of Northglenn's Water Management Plan is to obtain replacement water from the South Platte River system from a series of shallow alluvial wells generally located in Section 17, T2S, R67W (9). Illustrated on Figure 4-2 are the proposed sites and the expected area of influence. The tributary well field will be used by Northglenn primarily as a supplementary source; the primary replacement water supply will be diversion from Grange Hall Creek.

Northglenn has applied for underground water rights for five shallow wells to be constructed on six potential well sites. The wells are expected to be 35 to 40 feet deep with a capacity of 720 gallons per minute.

Depletions to the South Platte River system will be fully augmented as if well pumping was a surface diversion. The time delay of the effect of pumping a well located a distance from the river will be accounted for in the plan for augmentation currently pending in the Water Court. Through the Water Court process, Northglenn will have to provide augmentation water to the river at times when well pumpings actually deplete the surface flow. During the winter months the augmentation water will be provided from storage releases.

FIGURE 4-2


T. 2 S., R. 67 W.
8
5068
VERDALE
Well
PIPELINE
EAST 104 TH AVE
5074
5049
BR
5052
5040
Well
Wel
BULL
4
3
2
1
5050
MC KAY ROAD
Well
5054
17
5
6
FULTON DITCH DIVERSION HEADGATE
Sewage Disposal
5070
5057
Gravel Pits
80S
Scale 1" = 1000'

SOURCE: Wright Water Engineers

AREAS OF INFLUENCE
NORTHGLENN ALLUVIAL WELLFIELD
PROPOSED SHALLOW WELL SITES

Standley Lake Yield

During the period from 1941 through 1976 the average yield to the FRICO farmer from the Standley Lake system was 4.9 acre-feet per share. The lowest yield was 1.3 acre-feet per share in 1955 (10). According to a study by Blatchley and Associates, the amount of delivered water in 1932 was about 0.80 acre-feet per share, the lowest on record (11). In contrast, Northglenn has projected a future dry year yield of 5 acre-feet per share with an average yield of 7 acre-feet per share. This estimate is predicated on a number of assumptions:

1. The Bull Canal system will be lined, reducing the ditch loss from an historical average of 40 percent to about 10 percent in the future.
2. Losses in Big Dry Creek which historically have been between three and five percent (12) will be zero in the future and there may be an increase due to urbanization of the area adjacent to Big Dry Creek, which would increase runoff yields.
3. The Cities of Northglenn, Westminster and Thornton now own approximately 39 percent of FRICO's share and will take their water by pipeline directly from Standley Lake (13). This increase in City ownership reduces losses associated with agricultural use.
4. There is a better prediction of dry year yields based on improved snowpack estimates. This could result in a more efficiently managed water supply.
5. Previous studies have apparently been based on potentially erroneous data relative to the Croke Canal (a feeder canal from Clear Creek to Standley Lake). Revised studies by Northglenn's consultants have been based upon the change in reservoir water levels.
6. The reservoir was enlarged in 1965, and the larger volume will allow more efficient water use. In the dry year of 1977, which can be compared to 1954 -- the driest on record since 1941 -- the unit release was 5.9 acre-feet per share (14).

For the analysis of the Northglenn water management plan, the yields of 5 and 7 acre-feet per share for dry and normal years, respectively, are considered reasonable by EPA. This will also be approximately equal to the yield to the farmers because of lining the Bull Canal system and the 10 percent bonus provision in the Northglenn/FRICO exchange agreement. In the event the Bull Canal system is not lined, a yield of 5 acre-feet per share at the reservoir will be about 3 acre-feet per share delivered to the farm headgate.

One consideration which may reduce or have a negative impact on the yield of Standley Lake in the future is that the Croke Canal is the primary supply to Standley Lake and, with a 1902 appropriation date, is a relatively junior water right on Clear Creek. The Croke Canal generally is in priority only during winter and spring runoff periods. Because of increased efficiency in water use by other senior appropriators within the Clear Creek and South Platte River Basin, concern has been expressed that the yield of the Croke Canal may continue to diminish (12).

Bull Canal Water Distribution

Through the Northglenn/FRICO water exchange plan, payback water will be returned to the Bull Canal at the Bull Canal Reservoir site approximately 13 miles from the headgate of the Bull Canal. In 1979, there were 401 farmer shares upstream of the point of payback return and 1049 farmer shares downstream (15). Under certain flow conditions with some of the options considered, there is not sufficient water available in Big Dry Creek at the headgate of the Bull Canal to give the upstream shareholders the same yield as those downstream of the point of return. In a mutual ditch company, the share yield throughout the system is to be equal. Northglenn has stated, although no provision is made in any of the agreements or within the augmentation plan, that if such a shortage occurs, they will make water available either from holdover storage in Standley Lake, by pumping to the upper shareholders from the Bull Canal Reservoir, or by other means to insure the same yield upstream as downstream of the point of return.

Plan for Augmentation and Change of Water Rights

The contract between Northglenn and FRICO and the water rights owned by Northglenn provide a physical water supply to the City. In addition to the physical supply, it is necessary to insure there is a legal right for the City to use the water. Because the South Platte Basin is overappropriated, application to the Water Court for a new municipal water right for Northglenn would not provide any water on a legal basis except during certain limited times of the year when free water would be available.

The Northglenn Water Management Plan has three essential components in terms of providing Northglenn a legal water supply. These are as follows:

a. Change in water rights

b. Plan for augmentation

c. New water rights

Northglenn has filed a number of new water rights which form a part of the plan for augmentation. The filing for nontributary groundwater from beneath the City is pending with the Water Court.

The change of water right filing for the Northglenn Plan involves changing the decrees of the Church Ditch, Farmers High Line Canal, East Lake Water Company (carried in and served by the Farmers High Line Canal) and the Berthoud Pass Ditch.

The plan for augmentation includes as rights to be augmented: the Northglenn Reservoir (proposed); the Bull Canal Reservoir; the South Platte tributary wells (Nos. 1 through 5); and the Grange Hall Creek diversion at Irma Drive. Water rights which will be used for augmentation include the Lower Clear Creek Ditch, Burlington Ditch, Burlington Reservoir, Fulton Ditch, New Brantner Extension Ditch Company, Lupton Bottom Ditch Company, Brighton Ditch, and deep nontributary wells. Water rights on Grange Hall Creek and some storage reservoirs are also included.

The documents requesting approval of Northglenn's water supply plan were filed with the Water Court in Division 1, the South Platte River Basin, on August 31, 1979. Other water right users had until October 31, 1979 to protest the action and identify any rights which may be injured by Northglenn's plan. There will then be a period of discussion and negotiation between Northglenn and objectors to eliminate or reduce the number of issues. It is unlikely that a consent decree covering all issues can be negotiated and the case will be heard by the water judge.

Yield of Augmenting Rights

The yield of the water rights to be used for augmentation was reviewed from preliminary engineering studies provided by Northglenn. EPA concludes that it appears that the water rights represent sufficiently senior rights for augmenting purposes. Water used for augmentation comes from lands historically in agricultural production. Only the agricultural consumptive use can and will be used for augmentation.

Administration

The plan for augmentation is not specific to the details of the plan operation and administration. The State Engineer normally assigns only one Water Commissioner to each stream or stream segment for administration. The Northglenn augmentation plan as well as operation of the water supply system is very complex. Operation and proper monitoring will require measuring devices throughout the system and may even require measuring crop consumptive use as well as reservoir evaporation. The State Engineer's office has indicated to EPA that it needs at least one additional employee to properly administer Northglenn's proposed plan.

Ditch Protection

When shares in a mutual ditch company are used for augmenting purposes it is necessary to either transfer the water out of the ditch or divert water from the ditch back to the river source. The other ditch users must be protected from injury and may suffer a loss of water were Northglenn to transfer its shares out of the ditch entirely. Northglenn has stated they will work with the individual ditches to work out a means of insuring that the remaining ditch shareholders are protected.

This can be accomplished through the use of augmentation stations, by diverting water from the ditch back to the stream, or by leaving a certain percentage of their water right permanently in the ditch equivalent to the pro-rata share of seepage loss. The balance of the water right would be either left in the stream or changed to a new point of diversion where Northglenn could utilize the water for augmentation.

Thornton Enclave

As shown in Table 4-2 (reproduction of Table 3-1 for convenience), Northglenn expects to receive 885 acre-feet of wastewater from an enclave of Thornton which will be used as replacement water to FRICO by Northglenn. Northglenn's opinion is this flow does not require augmentation.

Whether or not augmentation water is required will be settled in the Water Court. Also, if there is less water available than the estimated 885 acre-feet, additional replacement water will be required which can be provided by increasing the diversion from Grange Hall Creek or the tributary well field.

The effect of requiring additional augmentation of the 885 acre-feet will be to require more surface water rights. The total diversions to be augmented in Table 4-2 would be increased by 885 acre-feet per year.

Grange Hall Creek

Grange Hall Creek is the most convenient and economical source of replacement water but is subject to water being physically available in the stream. Studies by Northglenn show the entire low flow of the stream may be diverted for Northglenn's use. Only during runoff from snowmelt or storm events greater than Northglenn's ability to divert will water flow down the stream. Except for runoff periods, Northglenn will have the capability of drying up Grange Hall Creek.

While Grange Hall Creek is a small intermittent stream, there are some existing water rights along the creek which are senior to Northglenn and must be protected. These rights are owned by one person and total 10.6 cfs. Northglenn intends to augment these rights when legally required to do so by releasing water into Grange Hall Creek from the Lower Clear Creek Ditch, or by releasing Grange Hall Creek drainage runoff to meet the demand of the lower water right users (15).

Legal Issues

In analyzing the water rights and augmentation plans of the Northglenn project, several legal issues were identified. These will be resolved through the Water Court process if necessary and the resolutions could have a significant effect on implementation of Northglenn's Water Management Plan if decisions were adverse to Northglenn.

TABLE 4-2

NORTHGLENN'S WATER BUDGET

1988 Conditions
(All values in Acre-feet)

	CONDITION							
	Option 1 Without Deep Wells		Option 2 650 af Deep Wells		Option 3 2300 af Deep Wells		Option 4 Return to Metro	
	Dry	Avg	Dry	Avg	Dry	Avg	Dry	Avg
Treated Water Requirements								
Household and Commercial	4140	4140	4140	4140	4140	4140	4140	4140
Irrigation (lawns and parks)	3200	2700	3200	2700	3200	2700	3200	2700
Total Water Required	7340	6840	7340	6840	7340	6840	7340	6840
Raw Water Sources								
Farmers Highline	69	137	69	137	69	137	69	137
Standley Lake Shares	1074	1504	1074	1504	1074	1504	1074	1504
Church Ditch	135	389	135	389	135	389	135	389
Berthoud Pass Ditch	120	608	120	608	120	608	120	608
Arapahoe Well No. 7	5	5	5	5	5	5	5	5
Proposed Deep Wells	0	0	645	645	2295	2295	0	0
FRICO Owned Water	5937	4197	5292	3552	3642	1902	5937(3)	4197(3)
Total Water Supplies	7340	6840	7340	6840	7340	6840	7340	6840
FRICO Exchange								
Net Amount Rec'd from FRICO	5937	4197	5292	3552	3642	1902	0	0
10% Bonus (500 AF min)	594	500	529	500	500	500	0	0
Reservoir Evaporation	316	236	316	236	316	236	0	0
Total Payback Requirement	6847	4933	6137	4288	4458	2638	0	0
Replacement/Wastewater Return								
Sewage - Northglenn	4016	4016	4016	4016	4016	4016	4016	4016
Sewage - Thornton Enclave[1]	885	885	885	885	885	885	885	885
Sewer Line Infiltration	300	300	300	300	300	300	300	300
Storm Runoff-Grange Hall Crk	1200	0	936	0	0	0	0	0
Tributary well Field	446	0	0	0	0	0	0	0
Total Water Available	6847	5201	6137	5201	5201	5201	5201	5201
Excess Physical Supply[2] (Total Available - Payback Requirement)	0	268	0	913	743	2563	To Metro Sewer for Treatment and release to South Platte River	
Diversions to be Augmented								
Grange Hall Creek	1200	0	936	0	0	0	To Metro Sewer for treatment and release to South Platte River	
Tributary Well Field	446	0	0	0	0	0		
Total Augmentation Requirements	1646	0	936	0	0	0		
Augmentation Rights Available	1985	2136	1985	2136	1985	2136		
Excess Water Rights to Meet Flow Requirements	339	2136	1049	2136	1985	2136		

(1) An enclave of Thornton will be connected to the Northglenn system.

(2) Excess water available in the system without augmenting which can be used for irrigation of Northglenn owned FRICO land.

(3) Water obtained from FRICO by purchase or condemnation of additional shares.

Listed below is a summary of some of the important issues identified during this analysis:

a. The plan includes successive use of water for both municipal and agricultural purposes. This includes FRICO water owned by Northglenn as well as water borrowed from FRICO. The legal question is whether this successive use is allowed.

b. Northglenn has claimed 100 percent depletion credit for water stored in Standley Lake. Historically, there has been a certain amount of return flow from agricultural use of this water. The legal question is whether or not any downstream appropriators have a right to return flow from this irrigation use.

c. Northglenn has claimed a total of 300 acre-feet per year of infiltration into the sewer system as part of the wastewater replacement credit. The basis for this is its contention that the source water is Standley Lake stored water and can be 100 percent consumptively used. It could be argued that some of the infiltration is storm water. Further it is questionable whether Northglenn has retained dominion and control over this water.

d. Standley Lake and the Croke Canal are decreed for irrigation and domestic purposes. The legal question is whether or not a change of water rights to municipal purposes must be included in the plan.

e. Another legal issue is whether or not a shareholder is entitled to water of a quality suitable for a use other than that for which the water has been historically used. This issue involves cities that desire, in the future, to use the Bull Canal system for domestic water supply.

f. Lining of the Bull Canal system will reduce the amount of seepage to the groundwater and may adversely affect irrigators who depend on such seepage. The legal question is whether these irrigators have a vested right to the water.

The above legal questions will be resolved through the judicial process if necessary. It is noted however, that resolution of all of the legal questions will not necessarily insure that all adverse impacts will be mitigated. For example, even though FRICO may legally be able to line the Bull Canal, this action could adversely impact downstream users that have historically depended on seepage water from the canal.

Summary of Legal Issues

EPA concludes that the Northglenn water rights applications, including change of water rights, and the augmentation plan are a logical approach to preventing injury to other vested water rights. Although there are a number of legal issues to be resolved and some changes to the water management plan as filed are likely, approval by the Water Court of a water supply plan for the City is likely. The probable effect of any subsequent changes to the plan during the court process will be to require more water to augment these changes in flow.

EPA concludes, based upon expert opinion, that 1) other complex plans with similar principles have been approved by the Water Court and this plan can be administered by the State Engineer; 2) the amount of water obtained from surface sources is reasonable based on historic ditch diversions and stream depletions; 3) the exchange plan will sufficiently protect FRICO shareholders; 4) through the Water Court process, out-of-priority diversions will be properly augmented; 5) the water rights to be used for augmentation are sufficiently senior for that purpose; 6) South Platte water users will be compensated for additional ditch losses.

Agricultural Productivity

The four water supply options of the Northglenn Water Management Plan are analyzed. Water supply alternatives which would develop West Slope water resources have not been quantitatively analyzed. Such sources do not affect East Slope agriculture detrimentally. Indeed, they may have some small benefit due to supplying new return flow water to the South Platte River.

The four options evaluated consist of three associated with implementation of the Northglenn proposal and an option to condemn or purchase the required amount of water from FRICO. Option 3, which is the exchange with FRICO using deep, nontributary well water is used as the baseline to which other options and agricultural impacts of alternative water supplies are compared.

A key issue in evaluating the proposed project is to determine its potential impact on agricultural productivity. The primary objective of this analysis is to quantify the agricultural impacts which would accompany implementation of the Northglenn Water Management Plan, and to compare them to the agricultural impacts which would result if Northglenn purchased or condemned sufficient FRICO shares to meet its raw water requirements. In 1979 the FRICO productivity was $342 per acre-foot of consumptive use. The corresponding South Platte productivity was $259 per acre-foot. (Figures used in the determination of impacts on agricultural productivity under the four options are summarized in the following sections. A more detailed presentation showing the derivation of these values is included in Appendix G.)

Water Availability to FRICO

The amount of water available to the FRICO farmers is dependent on the option chosen. The estimated farm headgate delivery for each of the options is summarized in Table 4-3. The values are based on the schematic diagrams, Figures 3-1 through 3-4 (oversized, back of report) and Table 4-2. The analyses ignore any benefit due to lining of the Bull Canal and assume that the farm headgate deliveries are equal to 60 percent of the sum of the releases from Standley Lake and the FRICO exchange return.

TABLE 4-3

ESTIMATED FRICO FARM HEADGATE WATER DELIVERIES

		Water (Acre Feet)(1)	
Option	Description	Average Year	Dry Year
1	Without deep wells	6390[2]	4706
2	650 acre-feet from non-tributary wells	6390[2]	4667
3	2300 acre-feet from non-tributary wells	6390[2]	4650[2]
4	Water from Standley Lake Wastewater to Metro	3572	788

(1) Equal to 60% of sum of FRICO exchange return and release from Standley Lake (see Figures 3-1 through 3-4).

(2) Under these conditions there is also excess water over repayment requirement available to irrigate Northglenn owned lands.

Augmentation Water

The required augmentation water from surface sources for the four options evaluated is summarized in Table 4-4. Some of the augmentation water will come from lands currently out of agricultural production and some will come from lands currently in production. To determine the impact of each option on agriculture, only that water to be taken from lands currently in production is of consequence.

TABLE 4-4

SURFACE WATER AUGMENTATION

		Total Required (acre-feet)		Water Removed From Currently Productive Agricultural Land (acre feet of consumptive use)	
Option	Description	Avg. Year	Dry Year	Avg. Year(1)	Dry Year(2)
1	Without deep wells	0	1646	1667	1520
2	650 acre-feet from nontributary wells	0	936	888	810
3	2300 acre-feet from nontributary wells	0	0	0	0
4	Water from Standley Lake Wastewater to Metro	0	0	0	0

(1) It is Northglenn's intention to remove the same amount of land from agricultural production in an average year as would be necessary in a dry year. The average year consumptive use associated with that land is indicated above (2039.2/1859.3 x dry year consumptive use.) This excess water would be available for irrigation of Northglenn owned land. The 2039.2 and 1859.3 are the average and dry year consumptive use values, in acre-feet, attributable to the South Platte land which is currently in irrigated agricultural production - Source: Wright Water Engineers, Inc.

(2) Figures obtained by subtracting consumptive use of currently out-of-production land (126 acre-feet) from total required.

TABLE 4-5

GROSS PRODUCTIVITY OF FRICO AND SOUTH PLATTE

IRRIGATED LANDS AFFECTED BY THE NORTHGLENN PROJECT

(IN MILLION DOLLARS)

Option	Description	FRICO[1]		SOUTH PLATTE[2]		TOTAL GROSS PRODUCTIVITY	
		Average Year	Dry Year	Average Year	Dry Year	Average Year	Dry Year
1	Without deep wells	1.95	1.76	0.16	0.15	2.11	1.91
2	650 acre-feet from non-tributary wells	1.95	1.75	0.33	0.31	2.28	2.06
3	2300 acre-feet from non-tributary wells	1.95	1.74	0.53	0.48	2.48	2.22
4	Water from Standley Lake Wastewater to Metro	1.49	1.04	0.53	0.48	2.02	1.52

[1] Based on $342/acre-foot of consumptive use of irrigation water. FRICO deliveries given in Table 4; irrigation efficiency = 65% in average year and 70% in dry year.

[2] Based on $259/acre-foot of consumptive use of irrigation water.

Note: All lands which are removed from irrigated agricultural production are assumed to have a dry-farming productivity of $60/acre.

Sample Calculation - Option 1, Average Year:

FRICO

Farm Headgate Delivery = 6390 A-F
Productivity of Irrigated Land = (6390)(.65)(342)=$1.42 M.
Irrigated acreage = 6390/1.04 = 6144 A.
Non-irrigated acreage = 15,000 - 6144 - 8856 A.
Productivity of Non-irrigated Land = (8856)(60)=$0.53 M.
Total FRICO Productivity = $1.95 M.

SOUTH PLATTE

Productivity of Irrigated Land = (2039.2-1667)(259)=$0.096M.
Non-irrigated acreage=(1667/2039.2)(1343.4) = 1098 A.
Productivity of Non-irrigated Land = (1098)(60)=$0.067 M.
Total South Platte Productivity = $0.16 M.

TOTAL GROSS PRODUCTIVITY = 1.95 + 0.16 = $2.11 M.

Agricultural Productivity Under the Northglenn Plan

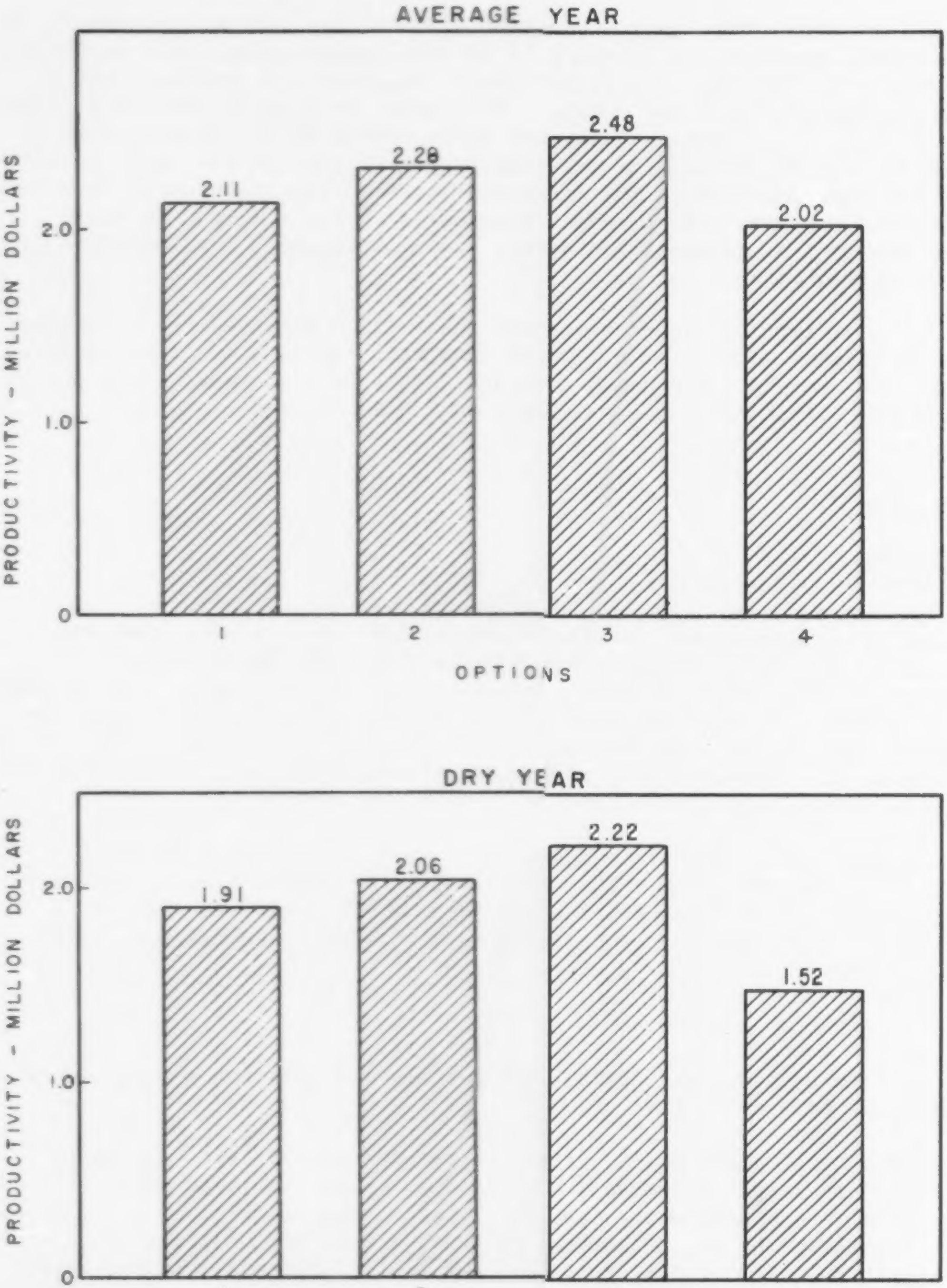
The individual and combined gross agricultural productivities for FRICO and South Platte lands under each of the four options considered are presented in Table 4-5. Anticipated productivities of the irrigated FRICO lands were computed using the farm headgate deliveries indicated in Table 4-3, assumed irrigation efficiencies of 65 percent in an average year and 70 percent in a dry year, and an estimated production value of $342 per acre-foot of consumptive use of irrigation water. It was assumed that water delivered to FRICO pursuant to the "bonus" provision of the exchange agreement would be used to bring additional land under irrigation. The productivities in Table 4-5 for Options 1 through 4 represent the sum of the productivities of irrigated and nonirrigated land in the FRICO and South Platte lands of concern. It should be noted that additional water is available under Options 1 through 3 in an average year and Option 3 in a dry year for possible irrigation of Northglenn owned lands. The basic calculations for agricultural productivity are presented in Table 4-5. Further explanation of the calculations is presented in Appendix G.

The analysis above uses an "average benefit" approach to analyzing the impacts of the Northglenn Water Management Program on agricultural productivity in the study area. It is agreed that a marginal benefit approach to productivity analysis would, in theory, be technically more correct. Such an approach recognizes that additional output (crop value) is not constant, but varies with the addition of incremental units of input (acre-feet of consumptive use of water). After careful consideration of the various theoretical and practical aspects of making this productivity analysis, however, EPA has concluded that use of average productivity parameters is adequate under these circumstances.

Option 4 does not include consideration of any increased productivity along the South Platte due to the additional water that would be discharged to the River via the Denver Metro Plant (433 acre-feet per month). This additional water is less than three percent of the flow in the South Platte below the Metro Plant. It is unlikely that this flow would result in any measurable increase in agricultural productivity in the study area, particularly in view of the fact that the South Platte ditches under consideration generally receive an adequate water supply. If the water was available to the South Platte ditches of concern it could be assumed to be available for the six months of the growing season. The maximum increased productivity along the South Platte for this additional water, based on $259 per acre-foot of consumptive use, would be $673,000 per year. Any increases in agricultural productivity beyond the confines of the study area were neglected.

As can be seen in Table 4-5, the option that contemplates maximum use of nontributary groundwater (Option 3) results in the greatest agricultural productivity (least impact). Option 4, which contemplates Northglenn's acquiring its entire water supply from FRICO by purchase or condemnation with wastewater discharged to the South Platte, results in the lowest agricultural productivity (greatest impact). Bar charts presented in Figure 4-3 graphically illustrate the gross productivities under the four options in both an average and dry year.

FIGURE 4-3



GROSS AGRICULTURAL PRODUCTIVITY

EPA concludes from this analysis that under the exchange program positive agricultural benefits are obtained if all the augmentation water is derived from deep wells (Option 3). If Northglenn implements an exchange which requires augmentation water entirely from other irrigators (Option 1), there will be some loss to agriculture, but productivity will be higher than if Northglenn did not execute an exchange agreement (Option 4). EPA therefore concludes that compared to the situation wherein litigation would have been successful, the proposed exchange, regardless of the source from which Northglenn obtains augmentation water, has significantly less economic impact on agriculture.

The long term exchange arrangement with FRICO enhances the likelihood that significant acreage of irrigated land will remain productive farmland during this century. EPA has determined that this plan meets EPA's policy to protect environmentally significant agricultural land.

WATER QUALITY

Water Supply

Options 1, 2 and 3 include a discharge into the Bull Canal. This effluent will degrade the existing water quality of the Bull Canal and in certain dry year conditions water below the discharge point will consist of 100 percent effluent. Potential health risks are in areas where public contact and exposure with the wastewater, particularly 100 percent effluent, are likely to occur. Potential health risks are also identified with using the wastewater for irrigation of vegetable gardens on farms and raw edible food crops grown for public sale and consumption.

Although it is not clear based on limited data whether the Bull Canal is currently suitable for use as a domestic water supply, future water quality of the Bull Canal below the discharge will be unsuitable as a water supply source primarily because nitrate concentrations will range between 12 mg/1 and 20 mg/1.

The State of Colorado defines raw waters suitable for potable water supplies as follows: (16)

> "These are waters which, after receiving approved disinfection such as simple chlorination or its equivalent or which after receiving standard treatment (defined as coagulation, flocculation, sedimentation, filtration, and disinfection with chlorine or its equivalent) will meet Colorado drinking water regulations and any revisions, amendments, or supplements thereto."

Standard water treatment as defined above will not effectively remove nitrate.

Annexation requirements of Frederick, Colorado require that lands brought into the town must provide sufficient water supplies for the annexed land. Landowners surrounding Frederick generally own shares in FRICO water delivered by the Bull Canal. Implementation of a plan which discharges effluent to the Bull Canal would render these waters unacceptable as a water supply for Frederick. The current use of the Canal is solely for agricultural use. Thus it is EPA's conclusion that the protection of these waters for a potential future water supply source is unnecessary and EPA recommends that Frederick explore other options to satisfy future water supply demands.

Fort Lupton is currently using a shallow well field along the South Platte River for their water supply source. However, this source has high nitrates. Sand Hill Lake is an option the Town is considering as a water supply source. Sand Hill Lake is filled by the Coal Ridge Ditch. Concern has been expressed that Bull Canal water will reach the Coal Ridge Ditch by way of the containment pond at the terminus of the Bull Canal. Fort Lupton is primarily concerned that nitrates in the Bull Canal resulting from Northglenn's plan will reach the Coal Ridge Ditch and render Sand Hill Lake unuseable as a water supply.

Nitrate concentrations in Coal Ridge Ditch are between 0.9 mg/l and 1.3 mg/l which is well below the water supply criterion of 10.0 mg/l. Sand Hill has a nitrate concentration of 5.5 mg/l probably due to agricultural runoff. The projected Bull Canal nitrate concentration in an average year ranges from 12 mg/l to 14 mg/l, depending upon the option.

Operation of the Bull Canal is intended to make optimum use of the irrigation water available. FRICO therefore does not deliver water with the intention of having it reach the containment pond since that water is lost. However, during occasional storm events and flushing of the Bull Canal, water does reach the pond and may be released to the Coal Ridge Ditch. This reservoir normally receives not more than 6 acre-feet of water in any one year (4).

The operational flexibility of the Northglenn Bull Canal reservoir should adequately control effluent mixed water entering Coal Ridge Ditch by way of the containment pond. However, tailwater from lands irrigated below the reservoir discharge point may enter Coal Ridge ditch and then Sand Hill Lake. Data to calculate the increased nitrate concentration in Sand Hill Lake are currently not available. EPA concludes that the Bull Canal will not significantly contribute water to Sand Hill Lake and therefore will not contribute to higher nitrate concentrations there.

Irrigation Water Quality

The projected total nitrogen concentrations in the Bull Canal at the point of wastewater discharge are presented in Table 4-6 . As a worst case condition in a dry year the canal below the discharge will consist of 100 percent effluent.

Sugar beets and barley are the nitrogen sensitive crops grown with Bull Canal water. The optimum nitrogen uptake of sugar beets is 81 pounds per acre per year (lb/ac/yr), and for barley it is 75 lb/ac/yr. The total nitrogen delivered is presented in Table 4-7 for the three options.

TABLE 4-6

TOTAL NITROGEN CONCENTRATION IN BULL CANAL

Option	Effluent Concentration	Average Year Concentration
1	15-20 mg/l	8.8-11.5 mg/l
2	15-20 mg/l	7.9-10.5 mg/l
3	15-20 mg/l	6.6-8.6 mg/l

TABLE 4-7

TOTAL NITROGEN DELIVERY TO SUGAR BEETS AND BARLEY

	Total Nitrogen Delivery (lb/ac/yr)			
	Dry Year		Average Year	
Option	Sugar Beets	Barley	Sugar Beets	Barley
1	42-56	42-56	25-32	14-18
2	42-56	42-56	22-29	12-17
3	42-56	42-56	18-24	10-14

The projected nitrogen concentrations in Northglenn's effluent should not exceed the recommended application rates for either sugar beets or barley. Concentrations will approach the optimum nitrogen uptake of sugar beets and barley in a dry year if effluent nitrogen concentrations reach 29 mg/l and 48 mg/l, respectively. At these concentrations, which are higher than expected, all the crop nitrogen demand could be provided by the effluent.

While total nitrogen concentrations are not expected to cause problems in either sugar beet or barley production, management of water applications to sugar beets will be necessary to satisfy Great Western's contractual agreements of no nitrogen after July 15 of each year.

TABLE 4-8

GUIDE TO THE USE OF SALINE WATERS FOR LIVESTOCK AND POULTRY

Total Soluble Salts Content of Waters(mg/l)	
Less than 1 000 mg/l (EC < 1.5)	Relatively low level of salinity. Excellent for all classes of livestock and poultry.
1 000 - 3 000 mg/l (EC = 1.5 - 5)	Very satisfactory for all classes of livestock and poultry. May cause temporary and mild diarrhea in livestock not accustomed to them or watery droppings in poultry.
3 000 - 5 000 mg/l (EC = 5 - 8)	Satisfactory for livestock, but may cause temporary diarrhea or be refused at first by animals not accustomed to them. Poor waters for poultry, often causing water feces, increased mortality and decreased growth, especially in turkeys.
5 000 - 7 000 mg/l (EC = 8 - 11)	Can be used with reasonable safety for dairy and beef cattle, for sheep, swine and horses. Avoid use for pregnant or lactating animals. Not acceptable for poultry.
7 000 - 10 000 mg/l (EC = 11 - 16)	Unfit for poultry and probably for swine. Considerable risk in using for pregnant or lactating cows, horses, or sheep, or for the young of these species. In general, use should be avoided although older ruminants, horses, poultry, and swine may subsist on them under certain conditions.
Over 10 000 mg/l (EC > 16)	Risks with these highly saline waters are so great that they cannot be recommended for use under any condition.

Source: Environmental Studies Board, Nat. Acad. of Sci., Nat. Acad. of Eng. Water Quality Criteria 1972

TABLE 4-9

RECOMMENDATIONS FOR LEVELS OF TOXIC SUBSTANCES IN DRINKING WATER FOR LIVESTOCK

Constituent	Upper limit
Aluminum (al)	5 mg/l
Arsenic (As)	0.2 mg/l
Beryllium (Be)	No data
Boron (B)	5.0 mg/l
Cadmium (Cd)	.05 mg/l
Chromium (Cr)	1.0 mg/l
Cobalt (Co)	1.0 mg/l
Copper (Cu)	0.5 mg/l
Fluoride (F)	2.0 mg/l
Iron (Fe)	No data
Lead (Pb)[a]	0.1 mg/l
Manganese (Mn)	No data
Mercury (Hg)	.01 mg/l
Molybdenum (Mo)	No data
Nitrate + Nitrite (NO_3-N+NO_2-N)	100 mg/l
Nitrite (NO_2-N)	10 mg/l
Selenium (Se)	0.05 mg/l
Vanadium (V)	0.10 mg/l
Zinc (Zn)	24 mg/l
Total Dissolved Solids (TDS)	10,000 mg/l

[a] Lead is accumulative and problems may begin at threshold value = 0.05 mg/l

Source: Environmental Studies Board
"Water Quality Criteria 1972"
National Academy of Science, National Academy of Engineers.

Water Quality Effects on Livestock

There is little quantitative information available concerning the tolerances of livestock to various water quality parameters. The permissible concentration of various substances in water depends, to some extent, on the daily water consumption of the animal. It appears that animals can tolerate higher salinities than humans, and it is conceivable that they differ in their tolerances of specific elements (17). Waters with high concentrations of nutrients (nitrogen and phosphorus) consumed by livestock can cause physiological disturbances such as gastrointestinal symptoms, wasting disease and death. Among the functions of animals, lactation and reproduction are generally the first to be disturbed by continuous use of water with high nutrient concentrations. Adverse effects of high salinity waters on livestock are due to the osmotic pressure of the total salts present rather than the toxic effect of any one constituent (17). In addition to the effects of the total salt concentration, some salts are specifically toxic to animals, at certain concentrations. Among the compounds of concern in water are nitrates, fluorides, and the salts of selenium and molybdenum. Tables 4-8 and 4-9 provide a set of recommendations for maximum levels of various elements in drinking water supplies to livestock. The Northglenn effluent quality is expected to remain within these recommended limits, thus posing no threats to livestock. Neither is it expected that drinking reclaimed water would make animal tissues unwholesome for human consumption.

Concern over the issue of nitritis (toxicity to cattle caused by high nitrite concentrations in silage) has been expressed. This situation occurs when nitrate is taken up by corn in high concentrations. When the corn is stored as silage and anaerobic conditions occur, the biological activity that occurs converts nitrate to nitrite which can be toxic. Nitrate applications to corn will not be excessive under the plan provided application of chemical fertilizers is reduced to compensate for nitrates in the wastewater. This problem can further be mitigated by maintaining aerobic conditions in stored silage. EPA concludes that this will not be a problem with corn silage grown under the FRICO system using Northglenn's effluent for irrigation water.

Groundwater Pollution from Lagoon/Reservoir Seepage

Subsurface investigations (18, 19) have been performed at the treatment plant and storage site. Exploratory borings indicate that the overburden soils and bedrock vary with respect to depth and classification. The bedrock is predominantly claystone with some claystone-siltstone deposits.

Water pressure tests were conducted to evaluate the permeability of the subsurface formations. The results indicate that the siltstone is relatively impervious with variable coefficients of permeability (1 to 60 feet/year). Higher permeabilities were detected at the interface of the claystone and sandstone lenses with a maximum value of 2400 ft/yr and a general range of 60 to 530 ft/yr. Claystone permeabilities are erratic and vary from 20 to 1000 ft/yr. The claystone becomes less permeable with depth.

Undisturbed samples collected at the storage reservoir site were tested and found to have a coefficient of permeability less than 1 ft/yr. This tends to indicate that leakage occurs in joints and fractures within the claystone.

Exploratory borings show an erratic free water level. Depths as shallow as 7 feet exist in the northwest portion of the site. This water is believed to be perched water caused from seepage from the adjacent Bull Canal. Other boring locations indicate water depths of 11 to 28 feet.

Although the permeabilities are generally low, there is a possibility for rapid movement through joints, fractures, and bedrock interfaces. An inactive fault trace may underlie the northwest corner of the proposed reservoir. Water movements along such fractures must be reduced to prevent groundwater contamination by the overlying wastewater and treated effluent. To satisfy this requirement the proposed Northglenn treatment facility and storage reservoir will be lined with random clay fill material from the excavation site. The design requires scarifying the reservoir and lagoon bottom soils to a depth of at least six inches and recompacting the soil to a 95 percent density. Northglenn states that if granular soils or fractured materials are encountered in the reservoir bottom, they will be covered with two feet of selected, compacted impervious fill material. EPA will require as an alternative to this that Northglenn consider moving the entire dike south to exclude such a fault trace if present. Resolution of the problem will be done following removal of overburden down to the competent zone. (See special construction condition in Chapter 5.)

The estimated seepage of the lined reservoir after 95 percent compaction is estimated to be 0.5 feet per year. The proposed lagoon and reservoir has an area of 110 acres. The anticipated total seepage volume per year is 55 acre-feet. Based on a void ratio of 25 percent in the soils below the reservoir, the radial movement of seepage is estimated to be two feet per year.

During the subsurface investigation, many holes were drilled or augered along the dam axis and throughout the area to be ponded, which have created possible zones of permeability. These penetrations are from 10 feet deep to 66 feet deep.

A study by the USGS and State Engineer's office involved two deep (1550 feet) monitoring wells within the impoundment area. These cased holes will be abandoned and replaced by agreement between Northglenn, the previous owner, and USGS. A third hole, 600 feet deep, was drilled by the Chen Engineering and Associates under contract with Northglenn.

Each penetration below the pond elevation base of 5120 feet needs to be considered as a possible source of fluid loss. EPA has determined that these penetrations will need to receive special attention before the compaction of the pond base or the dike construction.

EPA will require that all shallow test holes within the reservoir site that have a depth greater than 30 feet below the pond base must be plugged with concrete. Any test holes that have a depth of less than 30 feet must be back filled and compacted. The cased USGS test wells (BW-77-15B and BW-77-17B) must be pressure plugged with concrete from the bottom up to insure proper abandonment. (A special construction condition has been developed for this problem and is described in Chapter 5.)

In addition to the rate of movement, the concentrations of the potential contaminants must be considered. Biological oxidation in the aerated lagoon will reduce certain chemical constituents in magnitude while others will be converted to another form. For instance, the biochemical oxygen demand (BOD) will be reduced by at least 90 percent and ammonia/ammonium will be oxidized to nitrite/nitrate.

Some chemical components of wastewater which remain after treatment are potential groundwater pollutants. Most wastewater pollutants that pass into the soil will be filtered out, adsorbed, or exchanged with other ions within the soil matrix. Nitrates, soluble salts, and some heavy metals however, readily move through the soil matrix and are of particular concern as groundwater contaminants.

The clay liner in addition to EPA's special construction conditions on handling of the fault trace and sealing of wells, should limit the percolation of wastewater to an acceptable and practical volume as designed.

Monitoring wells are proposed for the vicinity of the treatment plant and storage reservoir site. Periodic chemical analysis will indicate any seepage effects on groundwater quality.

WATER RESOURCES

Lining of Bull Canal

Pursuant to the four-way agreement between FRICO, Northglenn, Thornton and Westminster, the City of Thornton is to pay FRICO to line the Bull Canal system and laterals (20). The purpose of the lining is to reduce seepage losses and improve farm headgate yield.

Seepage measurements of the Bull Canal system and Big Dry Creek below Standley Lake were made jointly by Wright Water Engineers, consultants for Northglenn, and Hydro-Triad Engineers, consultants for FRICO (21). No final report has been prepared, but interim results were made available for review. The extent of lining is yet to be determined. In certain areas groundwater may be flowing into the Bull Canal and lining these portions would be detrimental.

Historically, approximately 60 percent of the Standley Lake water released in the Standley system (22) has been delivered to the farmers. Data presented by Wright Water Engineers indicate that present seepage losses in Big Dry Creek between the outlet of Standley Lake and the Bull Canal headgate are between 3 and 5 percent. In the future, as the area urbanizes, it is expected losses in Big Dry Creek will reduce to zero or even show a gain. By lining the canal system, a future total system loss of 10 percent is estimated (23).

Reduction of seepage losses may lower groundwater levels and affect wells adjacent to the canal. Also, according to a study by Colorado State University for the Colorado Department of Natural Resources, improvement of irrigation efficiencies by lining may have an overall negative effect on water availability to agriculture in the South Platte Basin (24).

Groundwater Under Lands Taken Out of Production

Certain lands historically used for agriculture will, under the Northglenn plan, be taken out of production. The water rights associated with these lands will be used for augmentation by Northglenn. Removal of irrigation from land decreases the groundwater recharge. The effect of this reduction by Northglenn's plan has been estimated to be very small and will not have a noticeable impact. For example, an analysis of one parcel along the South Platte indicated an estimated groundwater level lowering of less than three inches as a result of removal of irrigation water. Continued removal of land from agricultural production for urbanization in the long term will have a more significant effect on groundwater levels.

TAXES AND LAND VALUE

Changes in Tax Revenue

Northglenn has purchased approximately 1840 acres of land in Weld County and 49 acres of land in Adams County in order to obtain water rights for the water resource management plan. This results in a net loss in taxes to both counties because municipalities are tax exempt. The loss of these irrigated lands from the tax rolls of Weld County and Adams County will result in a loss in tax revenues of $8,000-8,500 and $180-300, respectively.

The values are considerably less than the preliminary tax losses presented at the Northglenn Panel Meeting on September 13, 1979. The values presented at the Panel Meeting are not tax losses but represent the assessed valuation of Northglenn-owned land in Weld County.

Effect on Land Values Adjacent to Treatment Site

To evaluate the effects of a sewage lagoon on land values in an agricultural area, three realtors from Louisville, Colorado, and a land assessor from Boulder, Colorado were contacted (25). Louisville and Boulder were selected because the rural-residential-agricultural nature of land surrounding their wastewater treatment plants has similarities to the proposed Northglenn plant location. Louisville has a lagoon within one-half mile of the community and Boulder has a mechanical plant near its eastern edge.

Two of the three realtors in Louisville were not aware of the presence of the lagoon adjacent to their community. It has been EPA's experience that unless a lagoon is controversial and a public stigma is attached to the facility and the land around it, there is no real reason for land values to decline because of construction of the facility. Suburban residences immediately downwind of the Boulder facility are still in demand and it is estimated that prices there are depressed no more than five percent. The value of agricultural land around the Louisville lagoon has not decreased in value. Good farmland is in such demand that proximity to the lagoon is not a factor.

It is concluded that the effect of the Northglenn facility on surrounding land and residential values will be minimal if the treatment system and reservoir operate correctly. A decrease of up to five percent of residential value may occur but farmland and values should not be affected.

PUBLIC SAFETY

Reservoir Safety and Stability

The reservoir embankment stability analysis is based on two reports provided by Northglenn (18, 19). Review of these reports concludes that the subsurface and geological investigations for the proposed reservoir site have been adequate.

Earthquake Analysis

In the Earthquake Susceptibility Evaluation the Denver Seismic Zone is noted as the feature most likely to have a seismic effect on the Northglenn reservoir area. On page 15 it states that "it is unlikely that future earthquakes (in the Denver Seismic Zone) would exceed magnitudes greater than 5.5 to 6.0 (on the Richter Scale)" (19). This infers that a maximum design earthquake of magnitude 6.0 should be considered. On page 17 is stated "selected a pseudo static seismic coefficient of 0.05 g for the operational base earthquake and 0.10 g for the maximum design earthquake". The pseudo static seismic coefficient of 0.10 g was used in the stability analysis of the reservoir (26). For the Denver Seismic Zone an operational base criteria of 0.05 g, pseudo static seismic coefficient for an earthquake magnitude of 5.3, and 0.10 g for a maximum design earthquake of 6.1 Richter magnitude are reasonable based on U. S. Army Corps of Engineer criteria.

Embankment Stability Analysis

The stability analysis methods used are the most commonly used for this type of analysis. A detailed review of the adequacy of the analysis is beyond the scope of this review. However, safety factors arrived at in the analysis appear to be based on accepted criteria (27).

Seepage

The influence of underseepage and the resulting pore water pressures on the stability of the embankment are significant factors in the dam stability analyses. Pore water pressures should be monitored as indicated. However, this can be better accomplished by installing piezometers instead of observation wells, because the observation well will at best show a composite flow water surface. The results of the water pressure testing were correctly analyzed as primarily the result of secondary permeability.

Embankment Construction

The material to be excavated from the reservoir area appears adequate for the embankment construction. Recommended construction practices are along the lines of the Bureau of Reclamation Standards (28).

Northglenn's engineers call for a four foot freeboard with 18 inches of riprap on the reservoir face of the embankment. The freeboard of four feet was determined on the basis of an effective fetch of 2,355 feet and a design wind velocity of 63 miles per hour. Northglenn's engineers have considered wave run-up in the determination of freeboard.

An impervious asphalt liner will be placed along the inside face of the embankment from top to bottom to prevent wave action damage to the embankment. The asphalt liner will consist of a 3½ inch layer of hydraulic asphalt concrete, a 1½ inch thick binder course and a 5-inch drain course. Based on the analysis described by Mostertman (29) it would appear that with the use of an asphalt liner the wave run-up would result in a required freeboard in excess of 6 feet. Calculations for a riprap facing indicate that 50 percent of the stone used should have a diameter of 15 inches or greater rather than the 12 inches mentioned in the report.

Discussions with Northglenn's engineers indicate they have given consideration to potential embankment damages arising from ice formation or the potential of damages from earthquake generated waves.

Radiological Emergency

The U.S. Department of Energy operates, through a private contractor, the Rocky Flats nuclear weapons manufacturing plant which is almost ten miles west of Northglenn. There have been accidents at the plant whereby radioactive materials have been released into the air. State and Federal authorities have for some time been conducting investigations to determine the magnitude and extent of a threat a future incident may pose, and develop plans and policies to minimize effects.

The City of Northglenn is located just beyond the area known as the Category II area (10 miles radius) of the Rocky Flats Plant. The proposed water supply system, however, includes Standley Lake and Woman Creek which are inside the category I area (5 mile radius). Accordingly, EPA has determined Northglenn must comply with the provisions of the proposed *Radiological Emergency Response Plan for Rocky Flats.*

State officials have been waiting for several months to distribute this pamphlet telling those who live within 10 miles of the Rocky Flats nuclear weapons plant what to do in case of an emergency there. Its distribution, however, has been stalled by two obstacles. First, state and federal officials can't agree on what might be the worst case accident that could happen at the plant, or what precautions should be taken. Second, a test of the state's Disaster Emergency Services Agency revealed that the state would find it difficult to carry out the emergency response outlined in the plan. The current draft is now in the Governor's office while officials attempt to improve the state's emergency response plan.

AIR QUALITY

There are two air quality issues of concern. The first concern is the indirect adverse impact of project accommodated population growth on the region's air quality. The second concern is the potential direct impacts caused by odors from the treatment facilities.

Growth-Related Impacts

The funding of wastewater treatment and collection facilities that involve the addition of capacity to serve future population growth should be done in a manner encouraging the implementation of measures to reduce the existing air pollution problem. Population growth will occur in the Denver metropolitan area. Unless strategies to reduce air pollution (principally from automobiles) are implemented, air quality will not significantly improve. Funding of additional wastewater facilities does not cause air pollution, but it does support growth, both economically and locationally, by providing readily available services for sewage treatment and reducing development costs. Therefore, EPA believes that funds should be made available only where reasonable actions are being taken to deal with the air quality impacts of growth. (See Final Action for the Denver Overview EIS, the Colorado State Air Quality Implementation Plan, and Section 176(C) of the Clean Air Act.)

Accordingly, EPA requires:

1. A commitment from the elected officials of the local governments which are to be served by the proposed wastewater treatment facility to:

    a. Implement air pollution control measures considered reasonable for their area from the general list of measures outlined in Appendix C of the Final Action on the Denver Regional EIS for Wastewater Facilities and the Clean Water Program.

    b. Participate in the process established by the State of Colorado and the Denver Regional Council of Governments to revise the Denver element of the State Air Quality Implementation Plan.

    c. Support the implementation of the Denver element of the State Air Quality Implementation Plan as approved by EPA.

2. Design wastewater facilities, based on DRCOG population projections (or as revised during the State Air Quality Implementation Process) with capacity increases staged in accordance with the April 25, 1978 regulations.

3. The grant applicant (in conjunction with local jurisdictions) must develop and implement a sewer tap program which determines annually the number of taps available for new residential development and is consistent with the DRCOG population forecasts for 1980, 1990, and 2000.

4. Development which will be served by the additional capacity must be within the adopted regional urban service area boundaries and contiguous to existing development as stated in DRCOG's Regional Plan Policies. EPA requires evidence that local governments within the service area are promoting contiguous development through zoning actions, building permit approvals and tap allocations.

Northglenn will meet these requirements by abiding by certain grant conditions which are described in the Air Quality section of Chapter 5.

Potential Odor Problems

The Odor Emission Regulation of Colorado (30) prohibits emissions of odorous air contaminants from any single source such as result in detectable odors which are measured in excess of the following limits:

> For areas used predominantly for residential or commercial purposes it is a violation if odors are detected after the odorous air has been diluted with seven (7) or more volumes of odor-free air.
>
> In all other land use areas it is a violation if odors are detected after the odorous air has been diluted with fifteen (15) or more volumes of odor-free air.

The "worst case" for potential odor problems is to assume that the aeration system is not operating or that an algal bloom has occurred, and wind conditions do not allow for dispersion of the generated odor. Four "worst case" meteorological conditions were examined to determine approximately how far odorous air could travel from the proposed Northglenn treatment site before being diluted seven and fifteen times, respectively. The four "worst case" conditions tested were for:

most unstable dispersion (Stability Class A)

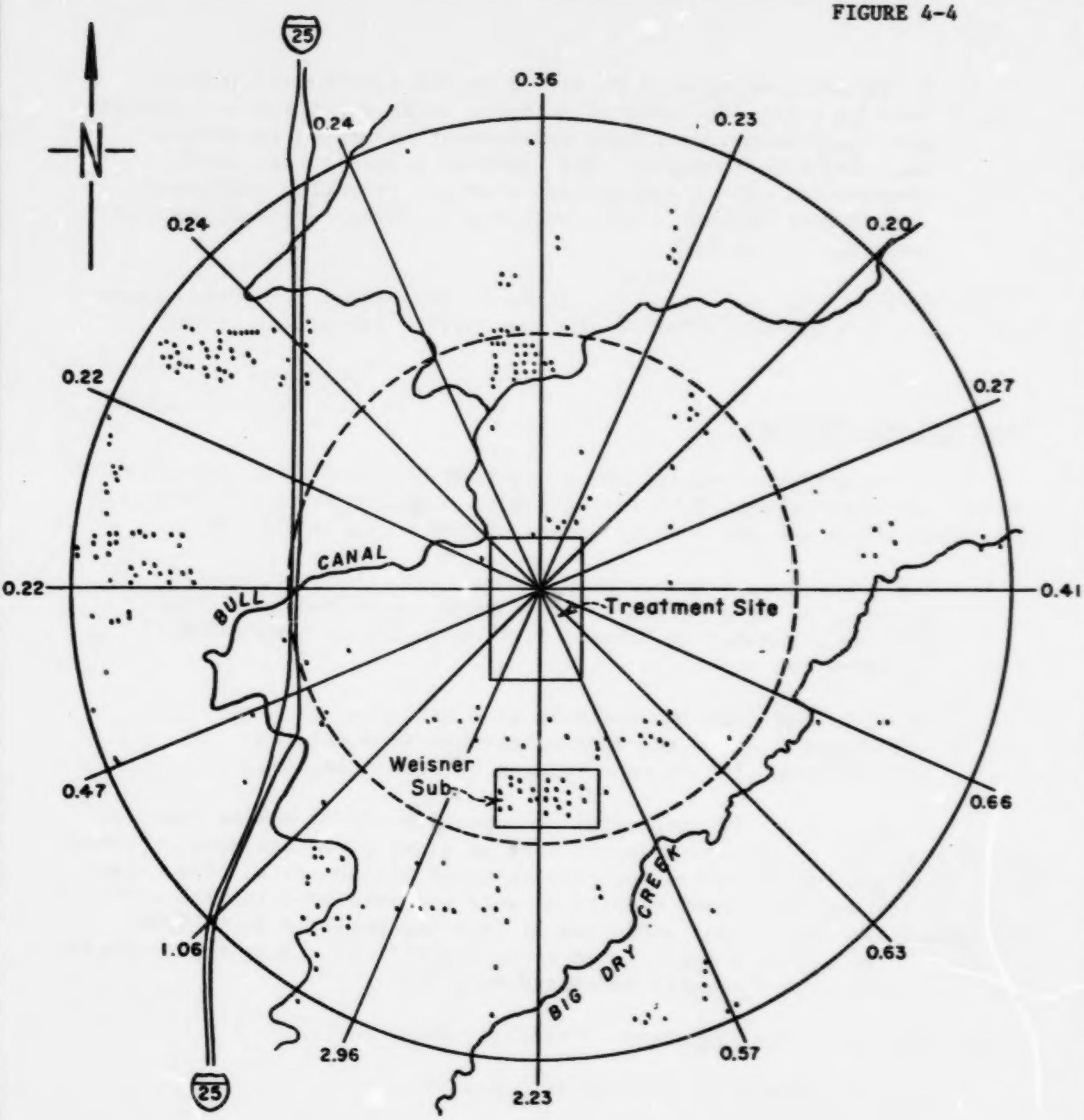
neutral dispersion (Stability Class D)

stable dispersion (Stability Class E)

very stable dispersion (Stability Class F)

The height of the odorous air, assuming the aeration system is not functional or a bloom has occurred, above the lagoons/reservoir is estimated to be ten meters (33 feet). This is the minimum emission height for an area source like lagoons. Accounting for this emission height, wind speed, and downwind distances for effective vertical mixing, the distances to seven and fifteen dilutions were calculated (31). The results of this analysis are presented in Table 4-10 and illustrated in Figure 4-4.

FIGURE 4-4


N
25
0.36
0.24
0.23
0.24
0.20
0.22
0.27
CANAL
BULL
0.22
0.41
Treatment Site
Weisner Sub.
0.47
0.66
BIG DRY CREEK
1.06
0.63
2.96
0.57
2.23
25

WORST CASE ODOR ANALYSIS
(using Class f wind stability - wind speed 3 to 7 mph
and an inoperative aeration system)

LEGEND

⁝ Buildings (Residential, Agricultural and Commercial)

—— Estimated area exceeding 15 dilutions

---- Estimated area exceeding 7 dilutions

Base: USGS, Weld County, Colorado 1978.

0 1
MILE

TABLE 4-10

ODOR ANALYSIS

Meteorological Condition	Distance to Seven Dilutions		Distance to Fifteen Dilutions	
	Kilometers	(Miles)	Kilometers	(Miles)
Unstable (Class A)	0.21	(0.13)	0.35	(0.22)
Neutral (Class D)	0.85	(0.53)	1.35	(0.84)
Stable (Class E)	1.27	(0.79)	2.37	(1.47)
Very Stable (Class F)	2.10	(1.30)	4.10	(2.55)

A very stable atmosphere, evident of a strong, low-level temperature inversion accompanied by low wind speed, is the "worst case" meteorological condition for the dispersion of odorous air. Hourly wind data from Stapleton International Airport show that Class E and Class F stabilities occur 6.7 and 16.7 percent of the time, respectively, for wind speeds from one to seven miles per hour (mph). The Class F category, for this analysis, is the worst case condition. Under the Class F category (winds 1 to 7 mph) the wind speed frequency is further separated into winds 1 to 3 mph and 3 to 7 mph. The wind speed frequency of 1 to 3 mph occurs less than half of the time, while wind speed frequency between 3 to 7 occurs about 66 percent of the time. The wind speed frequency by direction at Stapleton Airport is presented in Table 4-11. The diurnal drainage flow in the South Platte River Valley may be more evident with on-site meteorological data, but data from Stapleton International Airport are considered representative of long-term averages for this area.

Accounting for both the topography and diurnal air drainage flows in the vicinity of the proposed site and canals, the most likely areas affected by odorous air will be in a northeasterly to northwesterly direction from potential odor-generating sites. The area within a radius of 2.55 miles from the treatment site is calculated to be a maximum that could be affected by odorous air prior to 15 dilutions under worst case conditions. The maximum area for odorous air impact to achieve 7 dilutions has a radius of 1.3 miles.

Potential odor sources at the proposed plant include: 1) raw wastewater entering the plant; 2) dredging accumulated sludge from the aerated lagoons; 3) odors emitted due to plant upset conditions; 4) decaying algal blooms; and, 5) ultimate sludge disposal.

In the proposed facility raw wastewater enters through a closed "force main" pipe to a covered concrete inlet structure. The wastewater is then conveyed to the aerated lagoons through pipes that discharge below the lagoon water surface. Based on analyses prepared by Northglenn's engineer there will be a dissolved oxygen concentration greater than 2 mg/l at the plant site and therefore no sulfide odors would be generated.

TABLE 4-11

1960-1964 Hourly Relative Frequency Wind
Data Summarized for F Stability from
Stapleton International Airport, Denver, Colorado (2)

Wind Direction	Wind Speed Frequency % (1-2 mph)	Wind Speed Frequency % (3-7 mph)	Total % (1-7 mph)
N*	0.25	0.36	0.61
NNE*	0.21	0.23	0.44
NE	0.19	0.20	0.39
ENE	0.24	0.27	0.51
E	0.26	0.41	0.67
ESE	0.29	0.66	0.95
SE	0.37	0.63	1.00
SSE	0.31	0.57	0.88
S	0.89	2.23	3.12
SSW	0.98	2.96	3.94
SW	0.47	1.06	1.53
WSW	0.32	0.47	0.79
W	0.18	0.22	0.40
WNW	0.13	0.22	0.35
NW	0.29	0.24	0.53
NNW*	0.18	0.24	0.42
TOTAL	5.56	11.11	16.67

*Wind directions that will affect the Weisner Subdivision which is the highest concentration of residences within one mile of the proposed facility.

It has been estimated by Northglenn's engineer that sludge will be removed from the plant every three to five years. Some odor is possible during dredging. Measures such as dredging only on calm days which limit the transport of odors or on days which the prevailing wind direction is away from developed areas would reduce odor complaints. Also, the operation should be well planned so the dredging process is completed in the shortest period of time and the sludge removed to the disposal site.

Final sludge disposal will be by tank truck injecting the sludge into nearby agricultural land. There are expected to be minimal odors from this operation.

Aerated lagoons generally are a reliable treatment method that have few plant upsets. The Northglenn plant design is based on a concept that has not been proven in full scale operation. The process according to Northglenn's engineer will control algae by limiting the carbon source through removal of alkalinity by total nitrification. Presuming the continued operation of the aeration system, there should be little likelihood of plant upsets and operational problems that would result in odors. However, it is more probable than not that algal blooms will occur each spring or early summer, and that odors from the decaying algae will be experienced. (See Appendix E.)

Considering the general southeast to southwest wind direction and speed in the vicinity of the plant during worst case stability periods, and the likelihood of strong odor problems at the plant, the frequency of odor problems for residences near the proposed lagoons is expected to be infrequent with the operation of the aeration facilities. Although residences within a half mile of the facility may experience doses of odor under certain wind conditions, the closest residential area, the Weisner subdivision, is not in the direction that the prevailing winds blow during expected worst case conditions. Odor problems are possible if discharges from the reservoir to the Bull Canal have high concentrations of algae. Distribution throughout the canal system could mean that the canals themselves could generate some odors. The frequency with which such canal source episodes may occur depends upon the independent probabilities of algal blooms, calls for irrigation water, and requisite meterological conditions.

ENERGY

Energy Sources

With the rising costs of conventional energy sources it has become necessary to evaluate the cost-effectiveness of alternative sources of energy. Several additional sources are available. Wind and solar energy sources are the most feasible alternatives to consider for this project.

Solar energy is a clean energy alternative. Several types are commercially available, the variation being in the medium used, i.e. air, water, etc., depending on the type selected and the solar characteristics of the geographical location.

The Northglenn project includes a control building at the aerated lagoon treatment plant. The building design has incorporated passive solar design features including window positioning and partial burying to conserve heat. The building design also has included a heat recovery system that will heat the building with heat recovered from aeration blowers.

Another form of alternative energy is the conversion of wind forces into electrical power.

For wind energy to be an economical power source the average annual wind speed should be greater than 10 mph - ideally at least 14 to 15 mph, since this criterion is essential for a cost-effective design.

An approximate cost of wind energy is $25/sq.ft. of rotor. The rotor area is dependent on the quantity of energy required. At current energy costs the capital recovery time for a wind energy system is 6 to 16 years, depending on the type of application

Wind energy could potentially be used to supply the power necessary to operate the aeration system of the proposed Northglenn treatment plant. The average annual wind speed at Stapleton Airport is 9.5 mph (31). This value is close to the critical value (10 mph). Anemometer data at the treatment plant site are necessary for final analysis.

Energy Demands

To ascertain the energy demands of the proposed Northglenn treatment system, the power requirements (KWH per year) for the installed aeration horsepower for the Northglenn site have been compared to the total estimated power requirements for the alternative of treatment at Denver Metro. The estimated power requirements herein presented for these and other systems are based on information presented in Appendix E.

The estimated energy requirements for conveyance for the proposed Northglenn system based on flows and information supplied by Sheaffer and Roland, Inc., is 0.75×10^6 KWH per year. To the previous energy requirements for Northglenn, a conservatively estimated 0.36×10^6 KWH per year should be added to account for sludge handling and disposal, Bull Canal Reservoir discharge pumping, chlorination, and other miscellaneous energy requirements. The energy requirement for the proposed lagoon system, conveyance and miscellaneous energy requirements is 6.88×10^6.

The energy requirement of the Denver Metro alternative includes the energy required for secondary treatment plus biological nitrification of Northglenn's share of the flow at the Denver Metro treatment plant. The estimated energy requirement is 4.14×10^6 KWH/yr.

The Northglenn system will provide irrigation water which has relatively high concentrations of nitrogen. With proper control of application rates by irrigators there may be a reduced need for fertilizer resulting in a savings of energy that would be required for the manufacture and application of fertilizer. This energy savings was not quantified nor included in the estimate of Northglenn's energy requirement since it is uncertain if farmers will actually change current fertilizer practices.

The estimated energy requirements for the Denver Metro treatment and for the proposed Northglenn system are summarized in Table 4-12. The results indicate that compared to other alternatives, the proposed Northglenn system is energy inefficient and requires 66 percent more than the Denver Metro wastewater alternative.

TABLE 4-12

COMPARISON OF ANNUAL ENERGY REQUIREMENTS FOR PROPOSED NORTHGLENN TREATMENT SYSTEM AND SELECTED ALTERNATES

Treatment	Annual Energy Requirements (KWH/yr)
Proposed Northglenn System	
Lagoon system only	5.76×10^6
Conveyance & miscellaneous	1.12×10^6*
Total	6.88×10^6
Denver Metro	
Without conveyance	3.13×10^6
With conveyance	1.01×10^6
Total	4.14×10^6

* The energy requirement necessary to pump make-up water is 0.41×10^6 KWH/yr. and is included in the total conveyance and miscellaneous requirement.

AESTHETICS

Visual Features

The proposed reservoir and lagoons will alter the topographic features of the immediate area. The greatest impact will occur during construction when exposed soil will contrast with surrounding vegetation. However, as vegetation establishes on the slopes of the facility this impact will be significantly reduced. Analysis of the visual features of the area indicates that the terrain of the area will aid in further reducing the visual effects beyond the immediate site.

The proposed facility, lagoons and reservoir, is illustrated on the cover of this report. The rendering is looking north with the Bull Canal illustrated in the upper left hand corner. Shown in Figure 4-5 and 4-6 is the facility in profile. Figure 4-5 is the north-south axis viewed from the west. Figure 4-6 is the east-west axis viewed from the south. The vertical and horizontal scales differ for illustration purposes. Figure 4-7 to 4-10 are "before" and "after" illustrations of the facility. Figures 4-7 and 4-8 represent the fiew from Weisner Subdivision, south of the proposed site. Figures 4-9 and 4-10 represent the view of the site from Interstate 25, north of the Base Line Road intersection (Weld County-Adams County Line).

EPA concludes that due to the revegetation effort planned by Northglenn and the low profile of the facility, the visual intrusion is a minor impact.

OTHER ISSUES

Noxious Weeds

Under Colorado State law, counties are empowered to establish weed districts. A district is responsible for controlling noxious weeds within its jurisdiction. If a complaint comes to the administrator of the district, (generally the County extension office) the landowner is notified that steps must be taken to prevent the weeds from going to seed. If corrective measures are not taken the administrator can spray the land and charge the landowner by adding the fee to his taxes.

Concern has been expressed that Northglenn-owned agricultural land may not remain in continuous cultivation and a noxious weed problem may develop.

Western Adams County currently does not have a designated weed district that encompasses the Northglenn-owned land. Southwestern Weld County does have a weed control district that does include Northglenn owned land. Northglenn is exempt from paying taxes. Therefore, should a weed problem develop on their land the weed district would not be able to assess cost to Northglenn through the defined channels. At this time there is no enforceable policy for controlling weeds on Northglenn-owned land in either Adams or Weld County. Northglenn staff members have, however, publicly expressed their intention to control weeds on city-owned lands.

Project Impacts Upon Urbanization

The Northglenn water resource management plan has significant implications for urbanization of the Denver area.

Following implementation of the plan, Northglenn will control water from the South Platte River that historically irrigated approximately 1390 acres of land. Future development of this land may be severely limited if water is not available. Should developers follow Northglenn's option to purchase agricultural water from the South Platte forms there could be a further reduction in agricultural lands as a result of the urban development. This "domino" effect, over the long-term, may have a major impact on the agricultural community around Denver.

The key to controlling this effect is in Northglenn's ability to manage their water so that as much of the land historically irrigated is maintained as such.

FIGURE 4-5

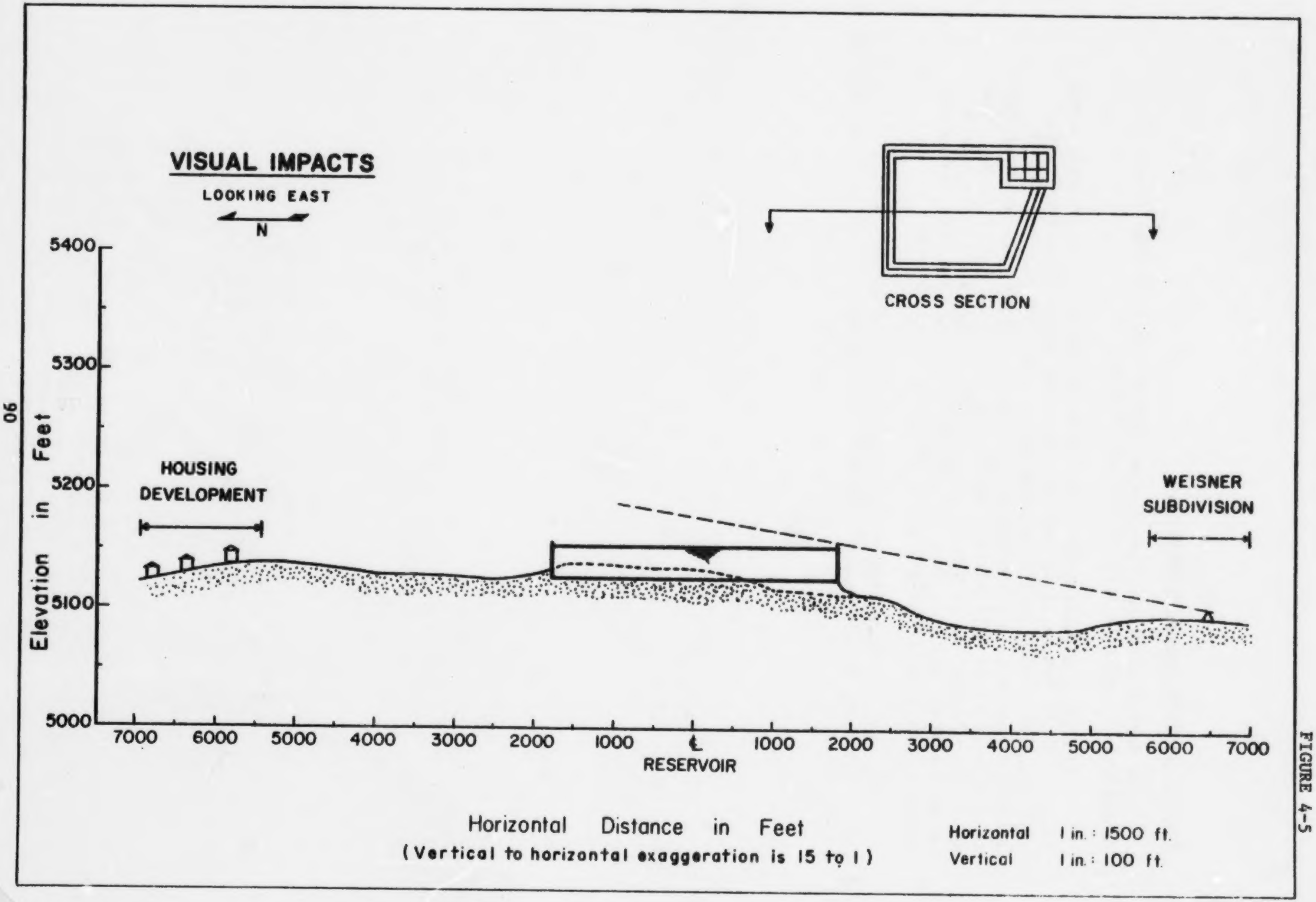
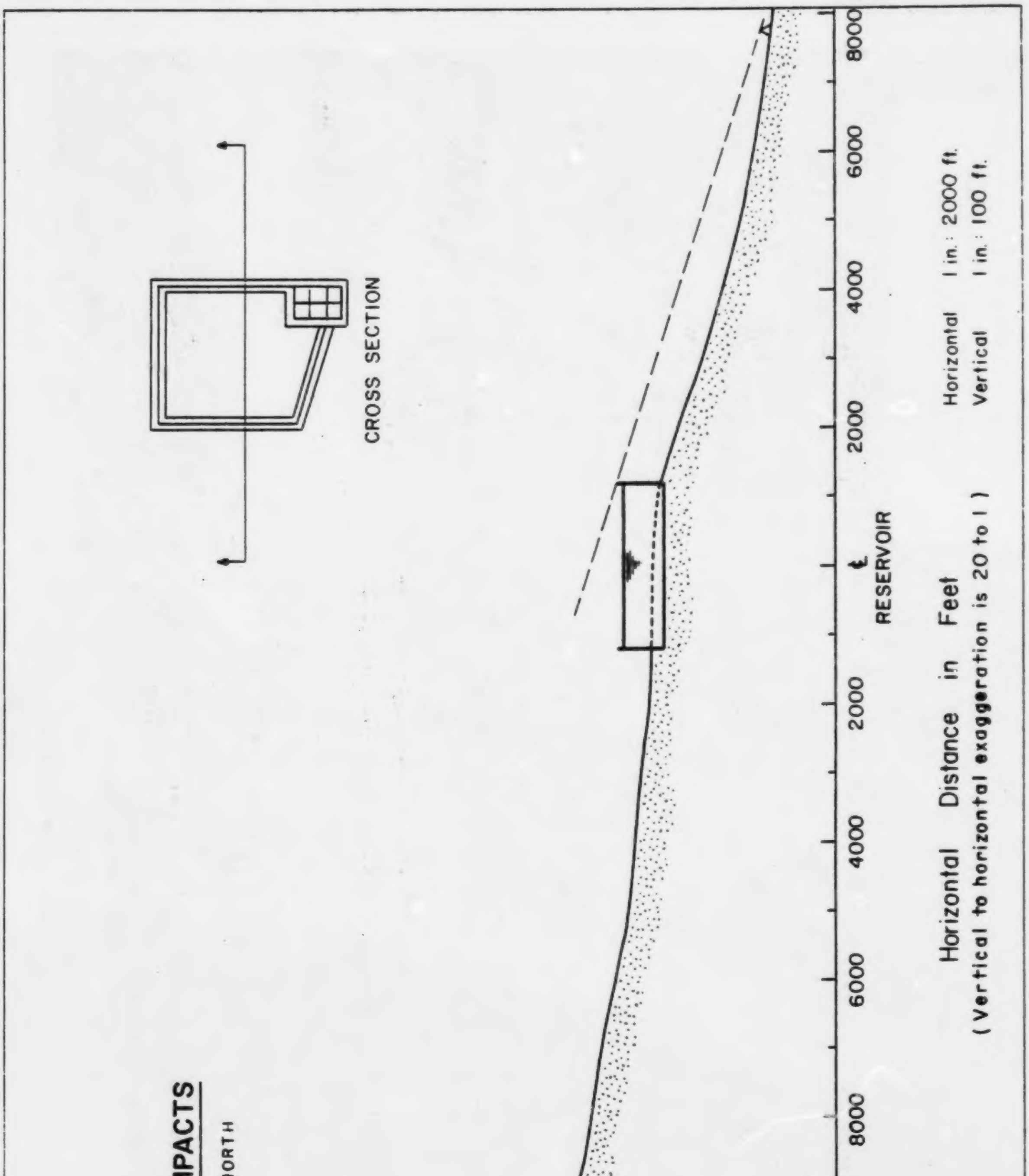

VISUAL IMPACTS
LOOKING EAST
N
CROSS SECTION
5400
5300
5200
5100
5000
Elevation in Feet
HOUSING DEVELOPMENT
WEISNER SUBDIVISION
7000
6000
5000
4000
3000
2000
1000
℄
1000
2000
3000
4000
5000
6000
7000
RESERVOIR
Horizontal Distance in Feet
(Vertical to horizontal exaggeration is 15 to 1)
Horizontal 1 in.: 1500 ft.
Vertical 1 in.: 100 ft.

FIGURE 4-6


VISUAL IMPACTS
LOOKING NORTH
N
HOUSING DEVELOPMENT
CROSS SECTION
RESERVOIR
Elevation in Feet
5400
5300
5200
5100
5000
12,000
10,000
8000
6000
4000
2000
2000
4000
6000
8000
Horizontal Distance in Feet
(Vertical to horizontal exaggeration is 20 to 1)
Horizontal 1 in.: 2000 ft.
Vertical 1 in.: 100 ft.

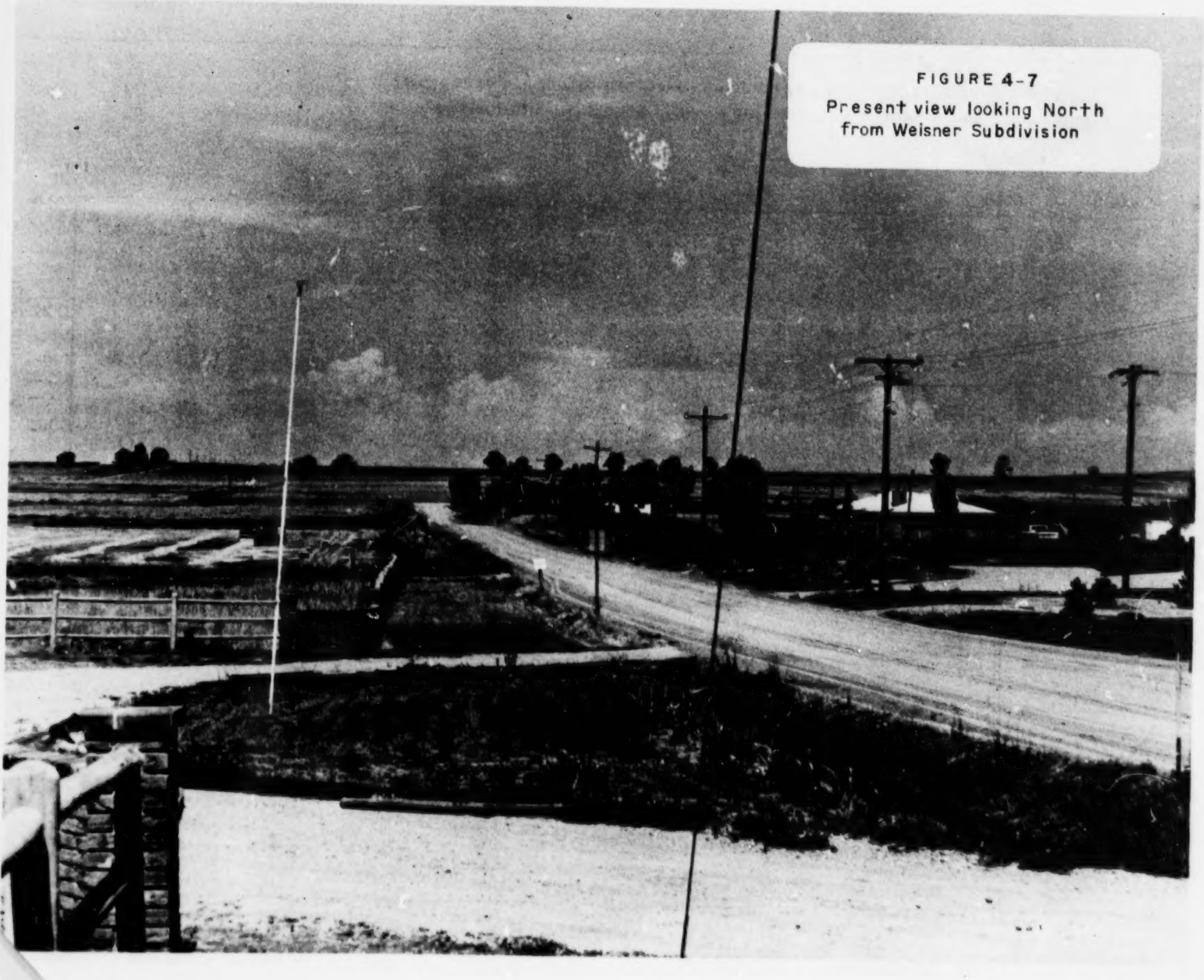
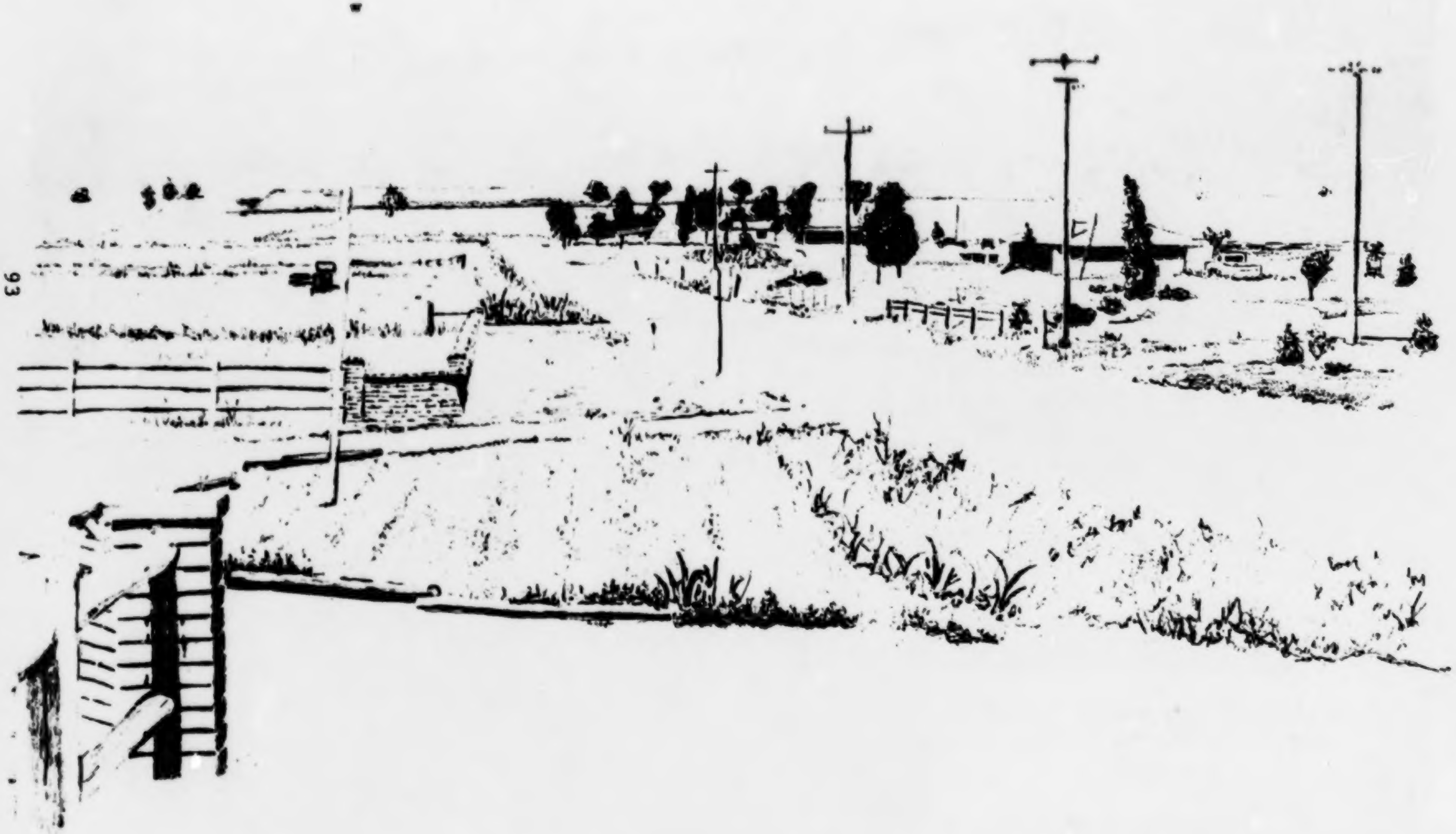


FIGURE 4-7
Present view looking North from Weisner Subdivision

FIGURE 4-8
Future view looking North from Weisner Subdivision



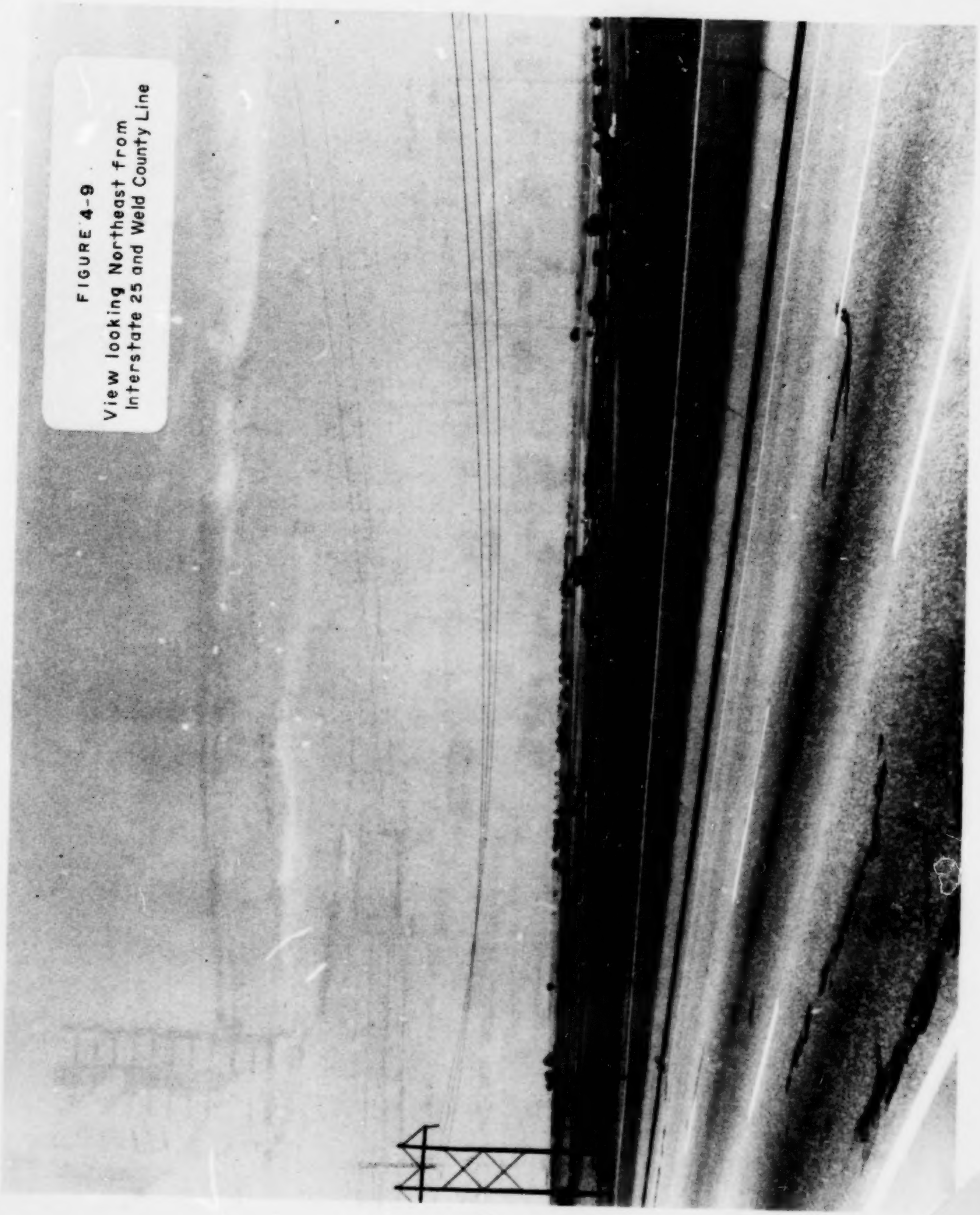
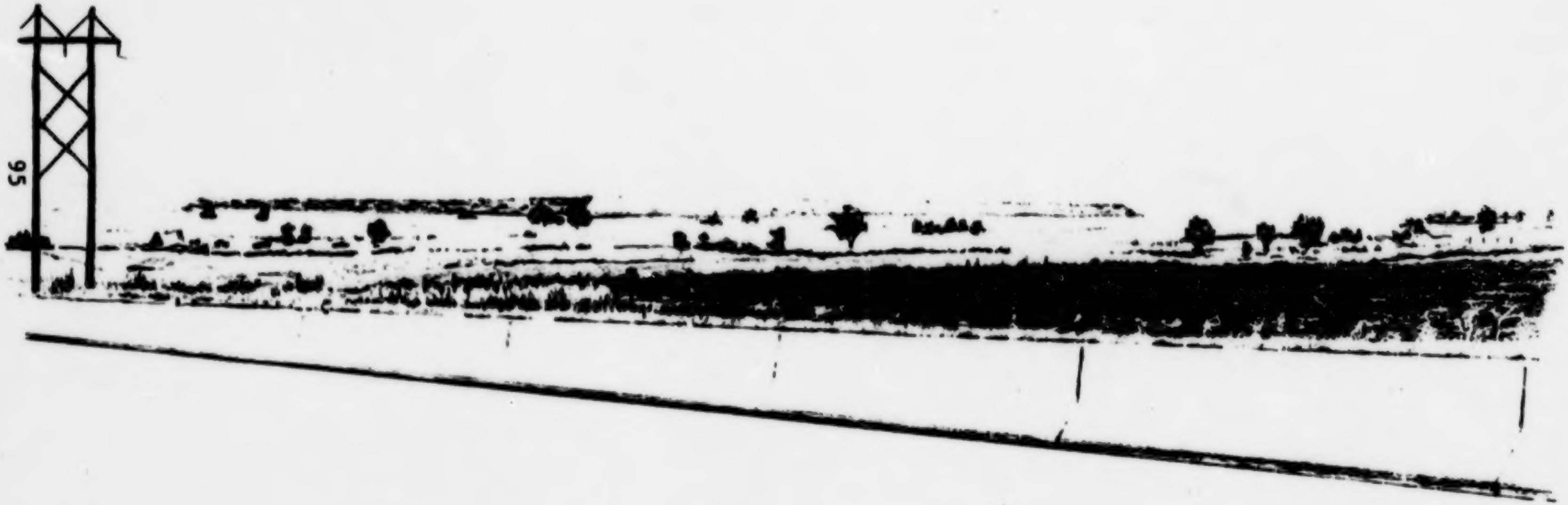


FIGURE 4-9

View looking Northeast from Interstate 25 and Weld County Line

FIGURE 4-10

Future view looking Northeast from
Interstate 25 and Weld County Line



CHAPTER 5

STEPS TO MINIMIZE ADVERSE EFFECTS

> *Farmers, ranchers, and environmentalists are allies now in their concern for the good stewardship of the nation's agricultural lands. This partnership is an immensely important one. Soil is the raw material of agriculture. We can pave it, or we can save it, knowing that whatever choice we make will profoundly influence the lives of unborn generations.*
>
> Gus Speth, Chairman
> Council on Environmental Quality (1978)

CHAPTER 5

STEPS TO MINIMIZE ADVERSE EFFECTS

Significant adverse impacts that may result from the proposed plan have been identified and discussed in Chapters 3 and 4. There are two mechanisms available to EPA and the State that will insure appropriate mitigation measures are implemented by Northglenn. These mechanisms are:

1) EPA Grant Conditions; and
2) State Enforcement of NPDES Permit Requirements

Under EPA's Construction Grants Program, a grant offer contains a list of requirements that the grantee must agree to in order to receive the grant. Usually these grant conditions involve certain steps that the grantee must accomplish during the construction phase (e.g. finalization of an operation and maintenance manual, completion of an industrial cost recovery system, etc.). Withholding final grant payment is the usual mechanism that EPA uses to insure compliance with grant conditions. Grant conditions to assure continuous requirements can also be imposed by EPA effective for the design life of the project.

Effluent discharge requirements of the EPA and the State are enforceable through the National Pollutant Discharge Elimination System (NPDES) permit system. This program requires that any municipality, industry, or other entity discharging into waters of the United States must do so with an approved discharge permit. The authority for the NPDES permitting system lies with EPA, but in many states, including Colorado, the administration of the system has been delegated to a state agency (in Colorado it is the State Health Department). The NPDES Permit includes appropriate limitations on the quantity, quality, and location of the discharge.

During the development of this document, extensive discussion has been held with Northglenn and various affected parties regarding the identified impacts and options for minimizing these impacts. Some of the specific mechanisms that will be used to implement and enforce the mitigation procedures are being negotiated, while certain ordinances designed to reduce adverse effects have already been passed by the City of Northglenn.

Northglenn has concurred that certain impacts will require mitigation, particularly those associated with degradation of Bull Canal and the resulting public health risks. EPA has developed the following mitigating programs for the impacts identified:

Public Health Measures

Additional disinfection to reduce risks due to public contact with the wastewater*

Additional disinfection or replacement of Dacono's nonpotable water supply*

Tailwater Control Plan*

Agriculture Reuse Manual

Commitment to use effluent for agricultural purposes

Additional measures to prevent groundwater seepage

Additional monitoring of the Bull Canal, groundwater, crops and soils

Resolution of Management Agency Designation

Previously required mitigating measures, including:

Compliance with the State Air Quality Implementation Plan, including:

a. Limiting sewer taps*
b. Limiting development to within urban service areas and contiguous to existing development by prohibiting connections to the Northglenn interceptor*
c. Conformance with Section 176(c) of the Clean Air Act regarding limitations on federal assistance

Protection of Treatment Capacity

Urban Runoff Controls

Erosion Controls

Energy Conservation

Water Conservation Efforts

Radiological Emergency Response Plan

Archaeological/Historical Resources

* Indicates EPA will negotiate for these conditions to be included in the State-issued NPDES Permit.

An explanation of the need for these measures and the applicable permit or grant conditions follows:

PUBLIC HEALTH - PUBLIC CONTACT WITH WASTEWATER

Farm irrigation practices and public recreation around the Bull Canal indicate that there is the potential for disease transmission through direct body contact.

The draft discharge permit from the Colorado Department of Health proposed that effluent be disinfected to a level of 1000 fecal coliforms per 100 ml. Detailed review of the medical literature (see Appendix C) indicates that public health risks are associated with 100 percent effluent chlorinated to 1000 fecal coliforms/100 ml. Because the project would entail uncontrolled use of effluent, meaning there would be human contact with the water during irrigation and possibly during use of the canal for recreation, a more stringent disinfection criteria should be applied. Therefore, the City of Northglenn has agreed to chlorinate the effluent to a level of 200 fecal coliforms per 100 ml. EPA will require that the 200/100 ml fecal limit become a requirement of Northglenn's NPDES permit. Whereas the City's engineer reports that the initial design included facilities to provide this level of disinfection, the operational plans did not. EPA anticipates that a dosage of 15 mg/l chlorine as projected by Northglenn will provide the necessary level of disinfection.

The NPDES permit effluent limitation shall be: "The City shall chlorinate the effluent prior to discharge to achieve a criteria such that the geometric mean of fecal coliform bacteria shall not exceed 200 colonies per 100 milliliters on a 30 day basis and shall not exceed a criteria of 400 fecal coliform colonies per 100 milliliters on a seven day basis."

PUBLIC HEALTH - DACONO IRRIGATION SYSTEM

The Town of Dacono has a nonpotable water system which draws water from the Bull Canal and is provided without treatment, for irrigation in certain parts of the town. The degraded quality of the water in the Bull Canal will create an unnecessary health risk within Dacono. Northglenn will resolve this problem either by substituting an alternative water source for Dacono's use in place of the Bull Canal water currently used, or installing and operating a disinfection system on the water Dacono receives from the Bull Canal. If disinfection is chosen, the system will be designed to achieve a level of disinfection acceptable to EPA which shall include a residual chlorine level of not less than 0.3 mg/l.

EPA is negotiating to include the following as an NPDES permit condition and will require as a grant condition: "Northglenn will undertake the cost of modifications, operation and maintenance for the Dacono nonpotable water supply to insure that the nonpotable water supply for the Town of Dacono is properly disinfected to protect public health."

Alternatively at Northglenn's expense, a replacement for this system could be provided, in which case this permit condition would be withdrawn. Northglenn shall consult with the Town of Dacono to obtain their concurrence with these plans.

PUBLIC HEALTH - TAILWATER CONTROL AT FREDERICK AND FIRESTONE

During irrigation periods, Bull Canal tailwater from lands adjacent to Frederick and Firestone flows through town streets. Northglenn has agreed with EPA to provide necessary facilities to control the tailwater so that it will not enter the Towns of Frederick or Firestone. The plan, which has been conceptually developed, will consist of three ponds that will receive the tailwater from collection ditches at the edge of these fields adjacent to the towns. Low dikes will reduce stormwater inflow into these ponds. Water from the ponds will be recirculated back to the irrigated land. (Should these fields be irrigated during rainfall, some diluted tailwater could flow into the streets.) According to the filings Northglenn has made with the Water Court, their position is that this water is from Standley Lake storage and impounding of this water will not create a water rights problem. EPA concludes that if the Water Court disagrees, this problem would then have to be resolved in Northglenn's augmentation plan.

EPA is negotiating to have the following as an NPDES permit condition and will require as a grant condition: "Northglenn will provide physical measures to prevent the flow of tailwater from adjacent agricultural land into the Towns of Frederick and Firestone or any other residential area. Consultation with Frederick and Firestone on the design and location of these facilities is necessary."

PUBLIC HEALTH - FOOD CROP PRODUCTION AND GARDENS

In 1979 there were no raw edible food crops grown in the FRICO-Standley Lake System. However, there is potential for such crops to be grown in the future. Also, there is potential for private gardens within the FRICO area to be irrigated with Bull Canal water.

Regarding the possible irrigation of private gardens, Northglenn has agreed to develop an educational plan that will inform farmers of the problem and discourge direct contact with the water and its use on private gardens.

The EPA grant condition will be: "Northglenn agrees to issue and reissue an advisory on an annual basis for the design life of the plant, to all shareholders of record in the Standley Lake Division of FRICO, and to all shareholders of record of any other division of FRICO to which waters from the Northglenn reservoir are diverted. This advisory concerns the constituents of the wastewater in the reservoir and a notice that such water should not be used for the irrigation of raw edible vegetable crops."

AGRICULTURAL REUSE MANUAL

The proposed project will result in delivery of reclaimed effluent and Standley Lake water to FRICO farmers. The reclaimed water is suited for agricultural uses, with the exception of raw edible vegetables as noted above. There may be some minor operational changes that can or should be made by the farmers for certain crops. For example, one change that would be advised is the modification of fertilization rates to compensate for the nitrogen content in the wastewater applied. The City of Northglenn has agreed to prepare an Agricultural Reuse Manual that will provide information on such matters. This manual will be available to all farmers in the FRICO-Standley Lake Division. Projections regarding water delivery and quality would be updated monthly. A preliminary outline of the manual is given below:

A. Water Yield Projections

    1. Snow survey
    2. Standley Lake Yield

        a. Bull Canal Shares
        b. Reuse Water

B. Water Delivery Projections

    1. Crop Projections

        a. Type
        b. Acres

    2. Standley Lake

        a. Cities
        b. FRICO Delivery

    3. Bull Canal Reservoir

        a. Wastewater
        b. Makeup Water

C. Nutrient Delivery Projections

    1. Bull Canal Reservoir Qualities by Month
    2. Recommended Commercial Fertilizer Application Rates
    3. Crop Advisories

D. Adjustments to Delivery Projections

    1. Standley Lake Quantity and Quality
    2. Bull Canal Reservoir Quantity and Quality
    3. Crop Advisories
    4. Field Monitoring Results

E. Distribution of Reports

    1. Agricultural Advisory Reports
    2. Water Quality Monitoring Reports

The EPA grant condition will be: "Northglenn will develop an Agricultural Reuse Manual to provide advice to farmers of the Standley Lake Division of FRICO on the use of treated sewage effluent for crop irrigation. Periodic public reporting in the advisory notices will be provided to the FRICO Board and to anyone requesting this information."

COMMITMENT TO USE EFFLUENT FOR AGRICULTURE

Implementation of the Northglenn agricultural reuse project requires the commitment of large sums of money, both from the City and EPA. Assurance must therefore be given that the City of Northglenn can and will continue the proposed means of wastewater treatment and disposal for the design life of the project-20 years. The proposed plan of agricultural reuse depends on the availability of sufficient agricultural lands to receive the effluent. While EPA concurs with Northglenn that future demand for this effluent should be adequate to insure this, Northglenn will develop a contingency plan whereby sufficient land under the City's control will be continuously committed to receive the effluent. This commitment can be in the form of land ownership by the City, irrigation easements, effluent sale for irrigation, or effluent lease for irrigation. The commitment is for a minimum of 20 years beyond the date of the grant award.

Northglenn purchased 1,836 acres within the Standley Lake Division incidental to water rights purchases. Fifteen hundred acres of this land are irrigated. Northglenn's engineer estimates that a minimum of 1,065 acres producing alfalfa will be sufficient to insure continuous disposal of its wastewater without adverse effects on groundwater. EPA agrees with this determination and therefore will require as a grant condition that Northglenn maintain 1,100 acres under their control for effluent disposal.

The EPA grant condition will be: "Northglenn shall assure that sufficient land, approximately 1,100 acres, in the FRICO-Standley Lake system is under their control--through ownership, lease, or contract--for the purposes of effluent disposal. This condition is binding for the 20-year design life of the project."

ADDITIONAL MEASURES TO PREVENT GROUNDWATER SEEPAGE

The northwest corner of the proposed reservoir may contain a fractured zone from a fault trace known to exist in the vicinity. If present, this would provide a zone of permeability potentially allowing communication of the impounded fluid with the groundwater of the immediate area. (Further analysis is provided in Chapter 4.)

Should the fracture pattern be encountered under the dike area or on the reservoir side of the excavation, there are two possible remedies: 1) move the reservoir south of the zone, or 2) design a sealing method. Additional sealing methods could include a combination of a partial membrane seal and compaction of a mixture of the local clays and proper additives to increase the plasticity in order to combine with the fractured zone material.

During the subsurface investigations of the reservoir site, many shallow holes were drilled. These penetrations in the pond area range from 23 to 60 feet below the final level of the reservoir. There are three deep well penetrations (600 to 1,500 feet) in the area of the reservoir. Two are USGS cased holes which exist near the northwest corner. The third hole, drilled by Chen and Associates, has been plugged with cement from the surface.

Northglenn proposes to use on-site clay material, at least six inches thick, compacted to 95 percent density. EPA considers that a six-inch liner may not be sufficient to insure a compacted permeability of less than 10^{-6} cm/sec which is the design criteria.

Where the liner is in contact with natural clays, a one foot liner would be a probable sufficient minimum. In areas where sand lenses are present, the liner should be at least two feet thick. The liner must be kept moist to prevent dessication cracks until completed and filling begins. Any open cracks or fractures which are in bedrock should be covered with a mixture of cohesionless sand and gravel to insure liner integrity after installation.

EPA will require the following grant condition: "During construction of the cut-off key for the reservoir dike, a trench will be made along the northwest boundary that will penetrate down to a competent zone in the Arapahoe formation. An examination of the exposed units will be made to determine if any fault traces cut across this portion of the reservoir. If a fault trace is located within the proposed reservoir area, either the dam will be relocated to exclude the trace, or the trace will be sealed with an impermeable liner before implacement of the clay liner. The results of these investigations and any mitigative measures must be inspected and approved by the Corps of Engineers, who will report the results to EPA.

All shallow test holes within the reservoir site that have a depth greater than 30 feet below the pond base must be plugged with concrete. Any test holes that have a depth of less than 30 feet must be back filled and compacted. The cased USGS test wells (BW-77-15B and BW-77-17B) must be pressure plugged with concrete from the bottom up to insure proper abandonment. EPA will be notified when the plugging is to take place so that a staff member can observe the plugging operation.

The thickness of the clay liner will be increased over the proposed 6 inch compacted seal for areas where the seal will be in direct contact with sand or sandstone. Clean claystone material must be used. In all cases the inplace claystone that will be used for a seal must be ripped up to the required depth before compacting to the six inch thick seal. The clay seal will be kept moist to prevent cracking. In areas where claystone is not present, a supply of claystone (from stockpile) must be spread in the area and a compacted seal of at least one foot thick provided."

ADDITIONAL MONITORING REQUIREMENTS

Northglenn has agreed to monitor the agricultural exchange program for the design life of the project. Northglenn will collect data that relates to the potential for surface water quality degradation caused by agricultural tailwater, groundwater contamination from reservoir seepage, agricultural lands or irrigation ditches, and contamination of water and subsequently crops by heavy metals, and pathogenic organisms.

EPA will require the following grant condition: "A monitoring program will be developed to include locations and depths of groundwater monitoring wells, locations of surface water monitoring, and procedures for monitoring crops. Pollutant parameters and monitoring frequencies must be given. Domestic groundwater supplies in the area that could be affected by the project must be identified and periodically monitored. The monitoring program shall be modified as information is developed on items such as the potential for crop contamination by toxic substances.

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(h) of the Clean Water Act. Northglenn will be required to retain all records and information resulting from the monitoring activities required by this permit condition including all records of analyses performed and calibration and maintenance of instrumentation for the design life of the project.

Northglenn must provide annual public reporting on the findings of the monitoring program. Northglenn must also identify any nonconformance with regulations concerning the level of contaminants in crops set by FDA, USDA, State agriculture and health departments and other government agencies. EPA shall pay no more than 50 percent of the federal share of the Step 3 project until the draft field monitoring program is submitted to EPA. EPA shall pay no more than 90 percent of the federal share of the Step 3 project until the field monitoring program is approved by EPA."

EPA will provide the Larimer-Weld 208 and Weld County copies of the draft program for their review. A 90-day review period will be provided. EPA will review the Larimer-Weld 208 and Weld County comments before the monitoring program is approved. Northglenn has submitted to EPA a preliminary program which is presented in Appendix I.

DESIGNATION OF MANAGEMENT AGENCY FOR THE NORTHGLENN PROJECT

The 208 Clean Water Program includes a process to identify needed wastewater treatment works, specify financial arrangements to develop these works, and set construction priorities. Each 208 area must also regulate all discharging facilities and develop policies and regulations to control all other point and nonpoint sources of pollution, identify which agencies are to implement the 208 plan, and assess the impact of the plan. Section 208 also calls for annual recertification of water implementation controls, including possible withholding of Federal grants for constructing publicly-owned treatment plants unless there is compliance with the plan.

It has been found that capital intensive and structural measures alone such as the construction of wastewater treatment facilities, cannot economically solve water pollution problems. Other nonstructural solutions must be developed, such as the implementation of land use controls to direct population growth to areas where wastewater treatment capacity already exists or can be readily provided.

The Clean Water Act requires that a management system be established in each 208 plan that assigns responsibilities to specific agencies. The system must not only assure implementation of the original plan but must also allow for annual updating and recertification of the plan.

The Act further requires that responsibilities within the system be assigned according to the following four broad functions: continuing planning; management; operations; and regulation. EPA has determined that these functions are properly managed when: a) local governments and organizations control implementation of the plan wherever possible; b) general purpose local governments are in charge wherever possible, because they are best able to integrate water quality programs with other local programs, and normally have the powers needed to deliver results; c) general purpose local governments delegate certain powers, functions, and responsibilities to appropriate existing agencies, so that disruptions are minimal and valuable expertise is put to use; and d) cities and counties coordinate wastewater management in the urban fringe areas where jurisdictions meet.

Management Agencies

As specified in the regulations developed for the Clean Water Program, 208 plans shall identify a specific Management Agency to implement each of the plan's programs. Each identified Management Agency shall have adequate authority as specified under Section 208(c) of the Act to establish the agency's legal, administrative and financial authority; appropriate reporting procedures; methods for coordination with the planning agency; and a description of the specific implementation responsibilities of the agency. The Governor shall assure that each Management Agency which has regulatory responsibilities has sufficient autonomy and regulatory authority to carry out its responsibilities effectively and on time. EPA may withdraw acceptance of a Management Agency designation and request the Governor to designate a new agency, or take other corrective action, if it is determined that the effectiveness of the Management Agency is inhibited by lack of sufficient autonomy.

Management Agencies can set up contracts that delegate operational responsibility to the operators of wastewater treatment facilities. The operating agency is responsible for day-to-day operation of the facility. For example, a sanitation district could enter into an intergovernmental agreement (IGA) as an operating agency with a Management Agency (such as a city or county) that would define its specific responsibilities for implementing the facility. The sanitation district would most likely hold the effluent discharge permit for operation, be eligible to receive Federal grants to construct wastewater facilities, set its own rates, and have complete control over the operation and maintenance of the facility. The city or county, as Management Agency, would review and approve facility expansion, set construction priorities, cooperate with the sanitation district to carry out the 208 plan, and be responsible for broad areas of land use planning and nonpoint source pollution control beyond the scope of the sanitation district.

Management Agency--Weld County or Northglenn?

The City of Northglenn is located within the 208 Areawide Planning jurisdiction of the Denver Regional Council of Governments (DRCOG) and has been designated as a Management Agency under the DRCOG Plan. As such, Northglenn is eligible to receive EPA Section 201 Construction Grants funds. Northglenn will have responsibility for any facility they construct, for issuance of bonds, grant administration, and operation and maintenance of the facility.

In accordance with the approved Larimer-Weld 208 Plan, the continuing planning functions in Weld County are the responsibility of the Larimer-Weld Regional Council of Governments. Weld County has been designated as a Management Agency under the Larimer-Weld 208 Plan for all unincorporated areas of the county. As a Management Agency, Weld County has a vital interest in the planning, operation and management of all wastewater treatment facilities constructed within their boundaries.

The proposed Northglenn wastewater treatment and reuse facility will service only the city limits within Northglenn with an eight mile interceptor through Adams County. The plant, however, will be located in southern Weld County, within the jurisdiction of the Larimer-Weld Regional Council of Governments' 208 Areawide Planning Region. This situation is unique in Colorado and there have not been any precedents established for designation of the Management Agency under these circumstances. There are four alternative methods of designation:

1) Weld County would be the Management Agency and grant recipient. Northglenn is the operating agency under the Larimer-Weld 208 Plan:

2) Weld County would be the Management Agency. Northglenn would be the operating agency and grant recipient;

3) Both Northglenn and Weld County would share Management Agency responsibility with Northglenn as operating agency and grant recipient:

4) Northglenn would be the sole Management Agency and grant recipient.

These alternatives are further identified:

1) Weld County would be identified as a Management Agency with Northglenn as an operating agency. Weld County would receive the grant and would pass through the funds and operating responsibilities to Northglenn as defined in an agreed upon intergovernmental agreement (IGA). Thus, Northglenn would be eligible to set its own rates and have control over the daily operation of the facility. Weld County would have the power to

review and approve or deny facility expansion, set construction priorities, cooperate with Northglenn to carry out the respective 208 plans, and be responsible for broad areas of land use planning and nonpoint source pollution control beyond the scope of Northglenn;

2) Same as above except Northglenn would be the direct recipient of all Federal construction grants for their wastewater treatment facility;

3) Both Northglenn and Weld County would act as Management Agencies as they have been so designated under their respective 208 planning agencies. Northglenn would also be identified as the Operating Agency under the Larimer-Weld 208. The sharing of Management Agency responsibility and the designation of Northglenn as the Operating Agency would have to be specifically defined in an IGA. Under this arrangement, Northglenn would be identified as the grant recipient and would be responsible for operating and maintaining the wastewater facility in accordance with provisions in the IGA:

4) Northglenn would be identified as sole Management Agency and thus would directly receive any Federal construction grant funds. Northglenn has been identified as a management agency under the Denver Regional 208 Plan because the service area is located in Adams County which is under the jurisdiction of DRCOG. If this alternative were chosen there would be no need for an IGA, as Northglenn would be solely responsible for plant operation, expansion or land use changes.

The requirements of both 208 plans (which have received State certification and EPA approval) must be met, through a formal Intergovernmental Agreement (IGA). Management Agency certification for both Northglenn and Weld County and execution of a bilateral IGA between Northglenn and Weld County will serve to notify the responsible areawide agencies, State agencies, and EPA of conformance with the 208 Plans. Alternative 3 establishes sharing of the Management Agency responsibility and therefore best accomplishes these goals. Consequently, EPA will require the development of the IGA based on sharing of Management Agencies responsibilities as outlined in Alternative 3 as a condition before receiving the final 10 percent payment of the grant.

Conditions of the Intergovernmental Agreement

The following issues are recommended by EPA as items to be included in an IGA between Weld County and Northglenn. Other issues can be included by mutual consent of both parties.

1. **Advisory for Agricultural Reuse**

   Develop detailed agricultural reuse manual and educational plan to advise farmers on the use of the effluent for all crops or private gardens using the Bull Canal system. Issue and reissue on an annual basis an advisory notice that the effluent water should not be used for irrigation of raw edible vegetable crops.

2. **Replacement or Disinfection of Dacono Nonpotable Water System**

   Specify the method of complete disinfection to provide a residual chlorine level or replacement of the nonpotable water system for the Town of Dacono. The Town of Dacono must be properly represented and advised on the solution to this problem.

3. **Tailwater Control**

   Development of physical measures to prevent the flow of tailwaters from adjacent agricultural land into the Towns of Firestone and Frederick, or any other residential area.

   Assure that Weld County and the communities of Firestone and Frederick are properly represented and advised on the solutions to this problem.

4. **Land Use Authority**

   The IGA should establish: a) Weld County's authority for zoning and land use planning in the area surrounding the treatment/reuse facility; b) Northglenn's authority for taps into the project interceptor; and c) Northglenn's authority for plant expansion. (Northglenn would not require Weld County approval for expansion within the boundaries of Northglenn.)

5. **Sludge Disposal**

   Northglenn would be creating sludge waste for possible disposal within the LWRCOG 208 plan area and therefore must comply with appropriate regulatory requirements in the disposition of such wastes. Northglenn plans to dispose of sludge through agricultural reuse on agricultural land in Weld County and Adams County.

6. Additional Monitoring Requirements

EPA will require, as a grant condition, a field monitoring plan of the agricultural exchange program for the design life of the project. Northglenn will collect data that relates to the potential for surface water quality degradation caused by agricultural tailwater, groundwater contamination from effluent seepage, agricultural lands or irrigation ditches, and contamination of water and subsequently crops from materials such as heavy metals or pathogenic organisms.

The monitoring program would be developed by Northglenn. EPA would provide the Larimer-Weld 208 and Weld County copies of the draft program for their review. A 90-day review period would be established and EPA would review the Larimer-Weld 208 and Weld County comments before the monitoring program is approved.

Northglenn should provide annual public reporting on the findings of the monitoring program. Northglenn must identify any nonconformance with regulations of the level of contaminants in crops set by FDA, USDA, State agricultural and health departments and other governmental agencies.

The IGA should consider the possibility of the Weld County Health Department processing some of these samples as a method of independent review. Northglenn would then reimburse Weld County for such expense. Assurances must be provided for the long term financial liability of Northglenn for this water quality monitoring program.

7. Protection of Groundwater Quality

Plans would need to be established to deal with possible groundwater pollution. Such plans should consider the groundwater monitoring program and a contingency plan to replace, at Northglenn's expense, the supply of water to residents presently dependent upon groundwater, if contamination is caused by this facility.

8. Limits on New Interceptors

A tap restriction prohibiting Northglenn from building any interceptors to the facility without prior Weld County approval should be included.

EPA will require the following grant condition: "The City of Northglenn and Weld County shall share responsibilities as Management

Agencies under their respective 208 Water Quality Plans. Designation of said responsibilities shall be incorporated into an Intergovernmental Agreement following as a minimum those EPA recommendations as outlined above. EPA shall pay no more than 50 percent of the federal share of the Step 3 project until the draft Intergovernmental Agreement is submitted to EPA. EPA shall pay no more than 90 percent of the federal share of the Step 3 project until the Intergovernmental Agreement is signed by the two parties and approved by EPA and the State."

See Appendix K for a draft of the Intergovernmental Agreement written by the City of Northglenn. Weld County has not agreed to this draft IGA. EPA believes the draft IGA basically complies with the above recommendations with two exceptions. The disinfection standard for the Dacono system shall be a residual chlorine level of not less than 0.3 mg/l and not as indicated in the draft IGA of a "fecal coliform level no greater than the level existing immediately upstream of the Northglenn treatment Facility." In addition, the IGA should be more specific in respect to sludge disposal requirements. The draft IGA contains additional provisions beyond EPA requirements including dismissal of pending litigation and payment in lieu of taxes.

PREVIOUSLY REQUIRED MITIGATING MEASURES

When EPA issued its initial environmental assessment on the Northglenn facility in September, 1978, several measures designed to reduce adverse impacts were identified. All Denver area communities which request EPA sewage funds must comply with EPA provisions as developed in the Denver Overview EIS. (see Final Action on the Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program, August, 1978). For the City of Northglenn these conditions include:

Compliance with the State Air Quality Implementation Plan, including:

a. Limiting sewer taps, and
b. Limiting development to within the urban service area and contiguous to existing development.
c. Conformance with Section 176(c) of the Clean Air Act regarding limitations of federal assistance

Protection of Treatment Capacity

Urban Runoff Controls

Erosion Controls

Energy Conservation

Water Conservation Efforts

Radiological Emergency Response Plan

Archaeological/Cultural Resources

With certain limited exceptions, EPA has accepted Northglenn's efforts to fulfill these conditions. The current status of these efforts includes the following:

Air Quality

The funding of wastewater treatment and collection facilities that involve the addition of capacity to serve future population growth should be done in a manner encouraging the implementation of measures to reduce the existing air pollution problem. These measures are described in Chapter 4 under the Air Quality Section.

Northglenn will meet the four requirements specified in the Denver Overview EIS through the following provisions:

a. A resolution adopted by the City Council indicating compliance with all measures developed in the Denver element of the State Air Quality Implementation Plan.

b. An ordinance limiting the number of taps available on an annual basis.

c. Ordinances prohibiting new taps along the proposed new interceptor.

On November 16, 1978, Northglenn adopted Resolution No. 78-92 which states in part that:

> "The City shall develop, implement and strictly enforce a comprehensive set of ordinances, policies and programs designed to produce and maintain ambient air quality standards:
>
> The City shall actively participate in the planning, research, and development of the Denver element of the State Air Quality Implementation Plan;
>
> The City shall cooperate to the fullest extent possible with the Denver Regional Council of Governments in the development of such a plan; and
>
> The City shall upon approval of such plan by the Environmental Protection Agency, enact and enforce an air quality ordinance for the purpose of ensuring compliance with the plan and with the goals of the Clean Air Act, as amended in 1977."

The City of Northglenn adopted, on December 21, 1978, an ordinance (Number 529) providing for a sewer tap program which annually determines the number of taps available for new residential development. The ordinance also provides a penalty for violation.

The ordinance specifies that it is unlawful for any person to make any connection to the City's sanitary sewer system without first obtaining the City Manager's approval of such connection. The ordinance indicates that the City Manager shall grant approval of applications for residential connections to the City's sanitary sewer system consistent with and not to exceed the following schedule:

YEAR	MAXIMUM ANNUAL RESIDENTIAL	CUMULATIVE RESIDENTIAL
1978	430	430
1979	430	860
1980	431	1291
1981	431	1722
1982	431	2153
1983	431	2584
1984	431	3015
1985	431	3446

Any connections not used in any one year may be added to the next succeeding year's allowable number of connections, except that in no year shall the total of all connections permitted exceed the cumulative total allowable for that year.

Any person violating the terms of this ordinance shall, upon conviction, be guilty of a misdemeanor and shall be subject to a fine not to exceed Three Hundred ($300.00) dollars, or imprisonment in the City or County jail not to exceed ninety (90) days, or both such fine and imprisonment.

In order that the proposed new interceptor will not unduly interfere with the adopted land use policies of Thornton and Adams County, and in order to provide for contiguous development, Northglenn has agreed to an EPA condition that prevents connections to the Northglenn interceptor. By City Ordinance adopted December 21, 1978, Northglenn amended its municipal code to include:

"Section 16-11-5. Prohibition Against Connections to The Northglenn Interceptor. It is unlawful for any person to directly or indirectly connect any collection system, interceptor, pump station, or other means of conveying sewage, to the Northglenn Interceptor as set forth on the map filed in the office of the Director of Public Works, for that section of the interceptor which is located outside of the City's corporate boundaries, and running from the incorporated boundaries to the sewage treatment facility, except the area between 120th Avenue and 136th Avenue, which exceptions are subject to approval by both the City and the United States Environmental Protection Agency."

Any person violating the terms of this ordinance shall be guilty of a misdemeanor and subject, upon conviction, to a fine not to exceed Three Hundred ($300.00) Dollars, or by imprisonment in the City or County jail not to exceed ninety (90) days, or both such fine and imprisonment."

On April 1, 1980 EPA published in the Federal Register an advance notice of proposed rulemaking to implement section 176(c) of the Clean Air Act. The notice describes a regulatory approach which provides that:

- States will establish procedures for the review of federal conformity determinations as a part of their state implementation plans (SIPs)

- Federal departments will establish procedures for determining the conformity of their actions with SIPs.

The federal departmental responsibilities may generally be satisfied by the use of existing notification and review procedures such as this EIS. Because the rulemaking may take almost one year to complete, EPA and other federal departments will establish interim procedures for determining the conformity of federal actions to approved and promulgated SIPs. Each agency including EPA must ensure that their environmental documentation to meet the procedural requirements of the National Environmental Policy Act will contain sufficient information to make the following findings:

1. All necessary state and federal air quality permits have been obtained for the activity. If a state variance has been issued, then it must be in conformity with the requirements of the Clean Air Act;

2. All population projections provided in the supporting data base for the action are consistent with the population projections used in the SIP;

3. The stationary, area and mobile source emission growth rates that are provided in the supporting data base for the action are consistent with the emission growth rates used in the SIP;

4. The increased emissions resulting from the action do not conflict with the emission reduction requirement of the SIP;

5. The increased emissions resulting from the action do not exceed the area's increment for the prevention of significant deterioration of air quality;

6. The increased emissions resulting from the action do not contribute to the violation of any national ambient air quality standard;

7. The action is consistent with all the transportation control measures that are provided for the SIP; and

8 The action complies with all other special provisions and requirements of the SIP.

EPA has reviewed the Northglenn Wastewater Facilities Plan and finds that it conforms with the Colorado State Implementation Plan (SIP) in accordance with Section 176(c) of the Clean Air Act. Before EPA makes a final conformity determination and proceeds with project funding, the formal views based on review of the final EIS of the Colorado Air Quality Control Commission and the Denver Regional COG will be carefully considered as well as those views of the public. Initial discussions have been held with DRCOG and the Air Quality Control Division. EPA believes that funding of the Northglenn project conforms with the Colorado State Implementation Plan (SIP) on the following basis:

Determination Requirements defined in the Advance Notice of Proposed Rule Making Federal Register, April 1, 1980.

Discussion of Finding

1.

The proposed facility does not require state or federal air quality permits for operation, because it does not emit materials during operation that contribute to standards violations. Construction emissions permits specifying control measures for fugitive dust have been obtained by Northglenn from the Colorado Air Quality

Control Division. (Three Emission Permits for Fugitive Dust were issued on August 23, 1979. Permits include numbers C-12,357-1FD, 2FD, and 3FD for site preparation, force main construction and the pump station.)

2., 3., 4., 6., The proposed facility will support growth in Northglenn, which is part of the Denver Region nonattainment area, by providing additional treatment capacity. Community growth contributes to air quality problems because additional people produce more auto travel and associated exhaust emissions. Auto emissions are the primary cause for nonattainment in the Denver region.

The residential growth supported by this project is reflected in the DRCOG Regional Growth and Development Plan (RGDP) which formed the basis for all analytical work in the SIP. The size of the wastewater facility is based on the 1976 DRCOG population projections for Northglenn which are also used in the RGDP. Thus, the projections of future air quality and the analysis of controls in the SIP account for the increase in auto emissions over time that are associated with higher residential population in Northglenn. Furthermore, as previously described Northglenn has adopted Ordinance Number 529 limiting the number of sewer taps available annually to 430 taps, which is consistent with the DRCOG estimates for growth rate. The City of Northglenn has agreed to an EPA grant condition that prevents any connections to the proposed sewer interceptor a provision which encourages contiguous growth as called for in the RGDP policy. In addition EPA has required that

	before facility expansion occurs or any new interceptor is approved, Northglenn must obtain another conformity determination. For these reasons, EPA believes that the subject considerations have been met and that no additional analysis is necessary.
5.	Not applicable in nonattainment areas.
7., 8.	The City of Northglenn has committed to participate in the development and implementation of the SIP effort. There are no specific measures required under the SIP for the city at this time.

EPA accepts these actions of the City of Northglenn to be in compliance with agency policy to minimize air quality impacts within the Denver urban area. Accordingly, EPA will require the following grant condition:

"Northglenn shall execute those items specified in City Resolution Number 78-94 regarding its intention to implement and enforce compliance with the provisions of the Denver element of the State Air Quality Implementation Plan. Northglenn shall maintain an ordinance providing for sewer tap limits as defined in Ordinance Number 529 adopted December 21, 1978 or as amended. The City shall maintain a prohibition against connections to the Northglenn interceptor for areas outside the current city limits as specified in Section 16-11-5 or as amended, of the municipal code. The City shall not expand the wastewater treatment facility or construct any new interceptor to transport sewerage to the wastewater treatment facility intended to service areas outside the current city limits unless they first obtain concurrence from the appropriate metropolitan planning organization designated under Section 134 of Title 23, United States Code, the State Air Quality Control Division and EPA that such actions conform to the State Air Quality Implementation Plan in accordance with Section 176(c) of the Clean Air Act. The Regional Administrator may withhold, condition, or restrict the Step 3 grant in the event that he determines that the provisions of Section 316 (b) of the Clean Air Act of 1977 have been met."

Protection of Treatment Capacity

According to EPA's cost-effective regulations the design life for the Northglenn facility is 20 years. Northglenn is expected to have a population growth rate of 3.1 percent per year resulting in a population estimate of 42,500 people by 2000. The wastewater treatment facility has been designed to accomodate flows for this population. Substantially higher rates of development due to rapid growth of Northglenn or expansion of the service area would create the need to expand the facility before 2000. Managing growth within these limits reduces the likelihood the city would need to expand the facility within the design period. Measures to protect treatment plant capacity are encouraged by EPA.

Northglenn's ordinances as described in the previous section under Air Quality, limit the number of new sewer taps on an annual basis and prevent any connections to the proposed interceptor. These ordinances are sufficient to protect treatment plant capacity. In order to ensure Northglenn will continue to abide by these restrictions EPA is negotiating to have the following NPDES permit condition:

> "The City of Northglenn shall maintain an ordinance providing for sewer tap limits as defined by Ordinance Number 529 dated December 21, 1978 or as amended by the City Council. The City shall maintain a prohibition against connections to the Northglenn interceptor for areas outside the current city limits as specified in Section 16-11-5 or as amended to the municipal code."

Urban Runoff Controls

The Denver Regional Council of Governments recommended in the 208 Clean Water Plan that urban runoff pollution be controlled by nonstructural controls such as pollution control ordinances (see Denver Overview Final EIS, Volume 1, page 33). The use of structural pollution controls to collect and treat urban runoff was believed to be too expensive to justify at this time. Accordingly, EPA determined that prior to granting funds for construction or expansion of wastewater facilities, the general-purpose governments within the proposed service area must show progress, in the form of ordinances adopted or recent efforts taken, towards implementing the nonpoint source controls recommended by the Clean Water Plan. Northglenn has met this requirement with respect to urban runoff control by adopting a new ordinance to their municipal code entitled "City Urban Runoff Drainage Ordinance".

Specific water quality purposes of this ordinance (Section 16-13 of the Municipal Code of Northglenn) include:

a) A coordinated program of creating upstream ponding for temporary detention of storm runoff waters;

b) Encouragement and facilitation of urban water resources management techniques, including detention of storm runoff, minimization of the need to construct storm sewers, reduction of pollution, and the enhancement of the environment.

The Urban Runoff Management Plan, based on engineering studies, indicates the location of all drainage facilities in the City, including those facilities which presently exist and those which are determined to be needed in the future. The facilities shown on the plan include all major drainage ways which directly or indirectly affect drainage within the City, and all conduits, channels, natural drainage courses, retention reservoirs, easements, culverts, bridges and other facilities which are required to provide for the drainage and control of surface waters within the basins of the drainage ways and to carry such waters to designated points of outflow or discharge.

Maximum citizen participation during all phases of the implementation of the storm drainage and flood control regulations is encouraged.

To insure citizen participation on actual construction projects, any time a project is proposed by the City to implement the Urban Runoff Management Plan, the City administration will hold a public hearing in the neighborhood where the project is to be constructed. The Planning Board and City Council shall hold public hearings prior to construction of the project.

EPA accepts this ordinance as written as suitable to meet the requirements of an urban runoff control plan. Accordingly, EPA will require the following grant condition:

> "Northglenn shall maintain for the design life of the project an urban runoff control plan similar to the provision contained in Ordinance No. 531 entitled "Urban Runoff Management Plan or as amended."

Erosion Control

Northglenn had agreed to implement erosion control measures by passing City Resolution Number 78-102, adopted December 21, 1978. The resolution called for adoption of an erosion control ordinance by June, 1979. Northglenn has failed to implement this provision to date. Accordingly, EPA will require Northglenn to adopt measures to limit erosion and to control sediment prior to final payment of the grant. Northglenn has been notified to prepare an ordinance specifying erosion controls and to follow: Guide for Erosion and Sediment Control in Urbanizing Areas of Colorado: Interim Guidance, prepared by the U.S. Department of Agriculture, Soil Conservation Service, Denver, Colorado, 1977. EPA will not award final payment of the Step 3 grant until the grantee has adopted appropriate ordinances or requirements to implement the erosion and sediment control requirements for new development as included in the DRCOG 208 Clean Water Plan.

Energy Conservation

EPA requires that during the planning or design of any wastewater treatment works, the consideration of solar energy technology and energy conservation techniques must be demonstrated by showing that energy requirements, particularly for natural gas, have been reduced as much as possible.

The Northglenn lagoon system is not a particularly energy efficient method of treatment (see discussion under energy demand in Chapter 4). The agriculture reuse system reduces energy requirements by continuing to produce agricultural products near the Denver area which will reduce transportation costs and by providing nutrient recycling should reduce the use of inorganic fertilizers produced with natural gas.

The Northglenn project includes a control building at the aerated lagoon treatment plant. The building design has incorporated passive solar design features including window positioning and partial burying to conserve heat as illustrated on the cover of this report. The building design also has included a heat recovery system that will heat the building with heat recovered from aeration blowers, by utilizing a heat pump.

EPA concludes no further measures are necessary regarding energy conservation.

Water Conservation

EPA regulations for cost-effective analyses specify that adequate consideration be made for reducing wastewater flow (generally called water conservation) for communities over 10,000 population discharging wastewater greater than 70 gallons per capita per day (gpcd). Under these circumstances, the grantee must use the estimated future reduction in flows for wastewater facility design.

The current average potable water use in Northglenn has been measured at 144 gpcd with an average of 91 gpcd returning as wastewater flow. Of the total wastewater flow, 18 gpcd are attributed to either industrial sources or groundwater infiltration, leaving an estimated 73 gpcd of residential wastewater flow. Because Northglenn's current use is so close to 70 gpcd criteria, EPA determined the formal cost-effective analysis of wastewater flow to be unnecessary, especially since Northglenn's plan includes several methods for reducing water use. The proposed methods include mandatory water saving devices for new construction and remodeling, outdoor irrigation reduction measures, and economic incentives for new taps to minimize water use.

Northglenn has adopted Ordinance Number 555 which establishes fees and charges for connections to the water and sewer utility system which bases charges on estimated use. The graduated fee schedule establishes additional costs for each 5,000 square feet of irrigated lawn with lower fees established if a resident installs drip irrigation or automatically timed spray irrigation.

In addition, Northglenn is also in the process of adopting a city ordinance to specifically promote water conservation. This recommended ordinance, entitled "Water Conservation and Plumbing Code of 1979," specifies that:

> "The Director of Natural Resources shall develop within 120 days of passage of this ordinance, an inventory list of commercially available fixtures designed to achieve conservation of water in an economically feasible manner. The inventory list shall include, but not be limited to the following:
>
> a. Indoor Criteria - Construction and Remodeling
>
> 1. Low flow toilets using less than 3.5 gallons per flush.
> 2. Air pressure toilets.
> 3. Shallow drip toilets.
> 4. Pressure reducing showerheads or water pressure valves.
> 5. Instant mixing thermostatic valve or similar device reducing time for tap outflow to reach desired hot water temperature.
> 6. Faucet aerators.
> 7. Self-regulating automatic shutoff faucets.
> 8. Dye table testing for toilet tank leaks.
> 9. Water conserving dishwashers.
> 10. Water conserving clothes washing machines.
> 11. Use of air cooled air conditioners.

B. Outdoor Criteria - Construction, Remodeling and Landscaping

1. Landscaping - For grassy areas, exclusive use of buffalo grass, western wheatgrass, crested wheatgrass, blue gramma, a mix of these or other grasses, or a comparable grass which will have the effect of minimizing the consumptive use of water applied to such grass or grasses for irrigation.

   For non-grassy, non-food producing areas, use of plants native to Colorado or states bordering Colorado.

2. Irrigation - In all cases in which the economic character of the development proposal is such that nonindigenous species of grasses, shrubs and trees are to be utilized in the landscaping plan, provision shall be made in the development proposal for an irrigating system which incorporates only equipment of the most water conserving type commercially available at the time the proposal is submitted for approval. At a minimum, irrigation systems shall:

   a) be equipped with a time activated automatic shutoff,

   b) be equipped with sprinkler heads of a type which provide the most uniform coverage feasible, and maximum feasible droplet size to reduce evaporation and wind disturbance of coverage,

   c) where slope of the proposed development so requires, irrigation systems shall be designed to control flow for the purpose of reducing runoff and increasing ground absorption.

3. Drainage Management - All development proposals shall include a drainage management plan incorporating at a minimum:

   a) collection of runoff from roofs, patios, sidewalks, driveways, streets and alleys.

   b) application or diversion of the water collected through 3(a) to the irrigation of landscaping vegetation within the development or adjoining developed land.

   c) the design, construction and operation of detention facilities shall conform to the requirements of the Division Engineer in accordance with the statutes of the State.

4. Swimming Pools - All swimming pools, both new and existing, shall be equipped with blanket pool covers which shall be employed whenever the pool is not in use."

Accordingly, EPA will impose a grant condition which states: "Northglenn shall develop a water conservation policy similar to their proposed ordinance entitled "Water Conservation and Plumbing Code of 1979, which encourages further reductions in wastewater flows. Said ordinance with amendments shall remain in effect for the design life of the project."

Radiological Emergency Response Plan

The City of Northglenn is located just beyond the area known as the Category II area (10 mile radius) of the Rocky Flats Plant. The proposed water supply system, however, includes Standley Lake and Woman Creek which are inside the Category I area (5 mile radius). Accordingly, EPA has determined Northglenn must comply with the provisions of the Radiological Emergency Response Plan for Rocky Flats.

State officials will distribute a pamphlet telling those who live within 10 miles of the Rocky Flats nuclear weapons plant what to do in case of an emergency there. Its distribution, however, has been stalled by two obstacles. First, state and federal officials can't agree on what might be the worst case accident that could happen at the plant, or what precautions should be taken. Second, a test of the state's Disaster Emergency Services Agency revealed that the state would find it difficult to carry out the emergency response outlined in the plan.

Providing these steps are completed, Northglenn can implement the recommendations of this plan that are applicable to their area. EPA cannot currently impose a condition on Northglenn which is dependent upon other agency actions outside the city's control. Therefore, with respect to this plan, EPA will apply as a grant condition: "The grantee shall develop a notification procedure consisting of distributing and redistributing annually, a pamphlet notice yet to be developed, approved, and furnished by the State, for notifying existing homeowners within the Category II area as defined by the State Radiological Emergency Response Plan. The grantee shall provide EPA with a copy of the procedures, as adopted prior to receiving a Step 3 grant from EPA, provided the State and the Department of Energy have completed this pamphlet at that time. If and when the pamphlet is formally approved at a later date, Northglenn shall then adopt and maintain for the project design life, those procedures necessary for the City of Northglenn as specified in the Radiological Emergency Response Plan."

Archaeological/Historical Resources

As noted in Appendix B, the survey of archaeological/historical resources conducted of the proposed interceptor route and reservoir site identified a possible area of interest consisting of a turn-of-the-century dump along the interceptor route. No other significant historical resources were identified. Northglenn discussed the situation with the State Historic Preservation Officer and has agreed to modify the interceptor route to avoid this area. EPA will apply the following grant condition: "If archaeological or cultural artifacts are unearthed, construction will be halted and the State Historic Preservation Officer will be consulted immediately. Accommodations will then be made as necessary for excavation and/or assessment of uncovered archaeological resources."

CHAPTER 6

EPA FUNDING CRITERIA AND ANALYSIS

"The open society, the unrestricted access to knowledge, the unplanned and uninhibited association of men for its furtherance--these are what may make a vast, complex, ever growing, ever changing, ever more specialized and expert technological world, nevertheless a world of human community."

J. Robert Oppenheimer
Science and the Common Understanding (1953)

CHAPTER 6

EPA FUNDING CRITERIA AND ANALYSIS

EPA FUNDING CRITERIA

The 1977 amendments to P.L. 92-500 enunciate a major policy of promoting the use of innovative and alternative waste management techniques, with special focus on the municipal waste treatment program. Though mentioned only briefly, innovative and alternative technology was explicitly encouraged in the 1972 law. Few projects applied such technology however, largely because of perceived greater risks and higher costs on the part of the water quality administrators, public health officers and consulting engineers.

Congress, therefore, used the 1977 amendments to require every community seeking an EPA grant for construction of wastewater treatment facilities to fully evaluate innovative and alternative treatment options. Innovative and alternative techniques taken together foster three central objectives: recycling and reuse of water and waste materials, energy conservation and recovery, and cost reduction.

Innovative refers to new and promising technology which is not yet fully proven under the circumstances of its intended use. In conventional treatment systems, innovative describes technology which reduces life cycle costs by 15 percent or more, or reduces the amount of energy required for waste treatment by at least 20 percent. Innovative can also refer to new technology which advances the state of waste treatment art.

Alternative technology is better known than innovative, offering treatment approaches which are clearly alternative to conventional secondary and advanced waste treatment processes. Included in this category are such techniques as land treatment, aquifer recharge, water reclamation and reuse, use of nutrients, direct industrial reuse of effluents, composting and land application of sludge, and anaerobic digestion of sludge to produce methane.

To encourage the use of innovative and alternative treatment facilities, Congress provided, in the act, that such facilities be funded at 85 percent of construction costs rather than the normal 75 percent. To provide funds for the increase, two percent (three percent in fiscal year 1981) of construction grant funds allocated to each state must be set aside for innovative and alternative facilities, with at least one-half of one percent earmarked for innovative facilities. This two percent set-aside is considered the maximum amount that states may use to supplement the basic 75 percent wastewater treatment works construction grant; therefore not all projects proposing innovative or alternative technology will receive the ten percent supplemental grant. Single-purpose projects using innovative or alternative techniques qualify for the 85 percent grant if their life cycle cost under a cost-effectiveness analysis does not exceed the life cycle cost of the most cost-effecitve conventional alternatiave by more than 15 percent. Within two years from the date of final inspection, EPA will pay 100 percent of the costs of modifying or replacing any innovative or alternative treatment facility which does not meet design performance standards and for which correction of the failure requires significantly increased capital or operation and maintenance costs.

EPA MULTIPLE-PURPOSE CONSTRUCTION GRANTS REQUIREMENTS

Generally EPA awards construction grant funds for wastewater treatment works which are shown to result in the minimum total resource cost over time and be adequate to meet Federal, State or local requirements. A cost-effectiveness analysis is used to screen different alternatives in order to determine the least-cost wastewater treatment alternative. Should a municipality desire to undertake a project that simultaneously performs a wastewater treatment function and another function, EPA can participate in the funding under multiple-purpose project funding criteria.

The current funding policy of EPA for the design and construction of most types of multiple-purpose projects is stated in Program Requirements Memorandum 77-4 (1). This memorandum enunciates the Alternative Justifiable Expenditure (AJE) method for cost sharing; it has been used since 1976, primarily in projects which involve combined sewer overflow and urban drainage problems. The AJE method is founded on the assumption that achieving multiple-purposes simultaneously should be less costly than achieving them separately, and all purposes should share in the cost savings. Thus, the funding for a project under this policy is less than it would have been had the project been designed for the single purpose of pollution control.

At the time the amount of funding for Northglenn was determined, EPA was in the process of developing a method for funding multiple-purpose projects which involve innovative and alternative technology incentives as provided by the 1977 Clean Water Act Amendments. In June of 1979 the Office of Water and Waste Management of EPA distributed "Strategies for Funding of Multiple-Purpose Projects"(2).

Seven alternatives were given for funding of multiple-purpose projects.

1. Keep the status quo. Use the Alternative Justifiable Expenditure (AJE) method for allocating costs, except for recreation projects where the eligibility level is the same as the single-purpose wastewater treatment project.

2. Make all multiple-purpose projects eligible at the cost level of the least costly conventional wastewater treatment single-purpose project.

3. Make all innovative/alternative multiple-purpose projects eligible at 115 percent of the single-purpose costs, and all noninnovative/alternative projects at the single-purpose level. (The actual rule in this option is somewhat more complex, employing a ratio of the present worth costs of the single and multiple-purpose projects.) This is the funding alternative selected by EPA for the Northglenn project.

4. Use the same eligibility rules as option 3, except make certain reclamation and reuse projects fully eligible--those in which the reuse replaces existing water withdrawal and leaves water in the stream which is required by a water-quality standard or a water-quality management plan, for a guaranteed period of 20 years. Expand the definition of "Enforceable Requirements of the Act" so as to make these reclamation projects eligible for placement on the state priority list.

5. Use the same eligibility rules as option 3, except that all reclamation and reuse projects would be fully eligible. Revise the priority system process so that the list is based on a ranking of all surface and groundwater quality problems. Also, expand the definition of enforceable requirements as in option 4.

6. Use the same eligibility rules as in option 5. Expand the definition of enforceable requirements, and institute limits on the proportion of state allotments which can be used to fund reclamation and reuse projects.

7. Fully fund "integrated facilities" as defined in Section 201(e) of the Clean Water Act, and all other multiple-purpose projects at the level of the single-purpose project.

It should be noted that the implementation of options 4 through 7 may require that a legislative change be made.

After the draft policy was issued in July 1979, EPA decided that multiple-purpose projects using innovative/alternative technology would be eligible for a grant based on option 3 as described above. The latest direction by EPA after consultation with the public and Congress is to retain the AJE method as described in option 1. EPA used option 3 for funding the Northglenn project. Option 3 employs this eligibility formula for innovative/alternative technology projects: 115 percent of the ratio of (a) the present worth cost of the most cost-effective single-purpose option, to (b) the present worth cost of the multiple-purpose project, with a minimum eligibility of 115 percent of the capital cost of the single-purpose alternative. This formula calculates the fraction of the multi-purpose project costs which are eligible for EPA funding. Portions of a multi-purpose project which involve innovative or alternative technology are eligible for an 85 percent grant. Other portions are eligible for a 75 percent grant. This grant amount is therefore 85 percent or 75 percent of the fraction of the multi-purpose project cost that is eligible. The extra 10 percent grant for innovative or alternative wastewater treatment technology grants is taken from limited, set-aside funds for each State. This money will be allocated at the direction of the State.

Since the decision on the eligibility of the Northglenn project was made, EPA has adopted the policy of funding new multiple-purpose construction grant projects that involve innovative or alternative technology under the Alternative Justifiable Expenditure (AJE) method (3). Under the AJE method the amount of EPA construction grant funding for the Northglenn project would be less than it would be under the option 3 method. Based upon previous commitments, EPA will use the option 3 method in order to determine the eligibility of the Northglenn project.

For EPA to participate in the funding of a multiple-purpose project, the following should apply:

1. The cost of the multiple-purpose project must not exceed the sum of the costs of the most cost-effective single-purpose options which accomplish the same purposes.

2. The primary and secondary environmental effects must be assessed in accordance with the NEPA review procedures, and the project must not have any significant net adverse environmental effects.

3. At least one of the purposes must be necessary to meet an enforceable requirement of the Act.

4. There is no purchase of existing facilities with federal funds.

5. The project meets the definition of treatment works, and the works are publicly owned.

6. The project is consistent with the adopted and approved water quality management plan.

7. For agricultural reuse projects a commitment to this use for the design life of the project is necessary.

Northglenn meets all of these requirements (see Chapter 1 - EPA decision).

Application of EPA Funding to the Northglenn Project

The application of option 3 funding for Northglenn requires that two costs be used, the present worth cost of the Northglenn Multi-Purpose Project and the present worth cost of the most cost-effective single purpose wastewater treatment alternative which was determined to be continuing the conveyance of Northglenn's wastewater to the Denver Metro wastewater treatment plant for treatment.

Although at present the wastewater from the City of Northglenn is treated at Denver Metro, there are costs associated with continuing this alternative. Expansion of the secondary treatment capacity of the treatment plant is necessary in order to enable the treatment plant to continue to meet its present effluent limitations and treat increased projected flows from the service area (2). In addition, the Denver Metro discharge permit requires that the treatment plant be upgraded to meet more stringent effluent requirements, including nitrification of the effluent. Capital costs of the treatment of Northglenn's flow at the Denver Metro facility were determined to be the difference between the costs of building facilities that are designed to handle the projected design year capacity with and without the design flows from Northglenn. The operation and maintenance costs of the treatment of Northglenn's flows at Denver Metro were determined by the prorated fraction of the total operation and maintenance costs.

If Northglenn were to continue to have its wastewater treated at Denver Metro for the 20-year planning period, the capacity of the existing interceptor system which conveys Northglenn's flow to Denver Metro would be exceeded (3). Costs were developed for an interceptor and force main system that could accommodate the increased projected flows. This system would serve Northglenn and part of Thornton. The cost of this system that was attributed to Northglenn was a prorated share of the capital and operation and maintenance (O&M) cost based upon Northglenn's flow and the total flow.

For the purpose of calculating the EPA funding of the Northglenn project, it has been determined that the multi-purpose project will be considered to be a wastewater treatment and agricultural reuse project. Therefore, portions of the Northglenn Water Resource Management Plan, which involve domestic water treatment and distribution, water supply, and urban runoff control, will not be included as part of the cost of the project. The purchase of the existing wastewater collection system by Northglenn was not considered as a cost of the project in the analysis since it involved the transfer of existing facilities between municipalities. The parts of the project that shall be included are the costs of required wastewater collection system changes, the conveyance of wastewater to the treatment plant site, wastewater treatment, wastewater storage, and measures taken to monitor and control potential adverse impacts of the reuse plan.

Shown in Table 6-1, the funding ratio for the Northglenn project is calculated to be .67. The construction costs of the eligible portions of the project were therefore multiplied by .67 to find the eligible fraction of each item. EPA Construction Grant funds may then be used to pay 75 percent or 85 percent of this eligible fraction. EPA has determined that only the storage reservoir and the facilities that are planned to monitor and mitigate impacts of the agricultural reuse system are eligible for EPA funding at the 85 percent level since these items relate directly to the alternative function of the project - agricultural reuse. The extra 10 percent grant is taken from limited funds that have been set aside for alternative wastewater treatment technology projects which will be allocated by the State of Colorado. It is therefore unclear at this time if this money will be made available to Northglenn.

The Step 3 EPA Construction Grant estimate was determined to be $6,948,000 if the alternative wastewater treatment technology funds are allocated to Northglenn and $6,503,000 if the alternative technology funds are not made available by the State.

TABLE 6-1

GRANT ESTIMATE

Funding Ratio:

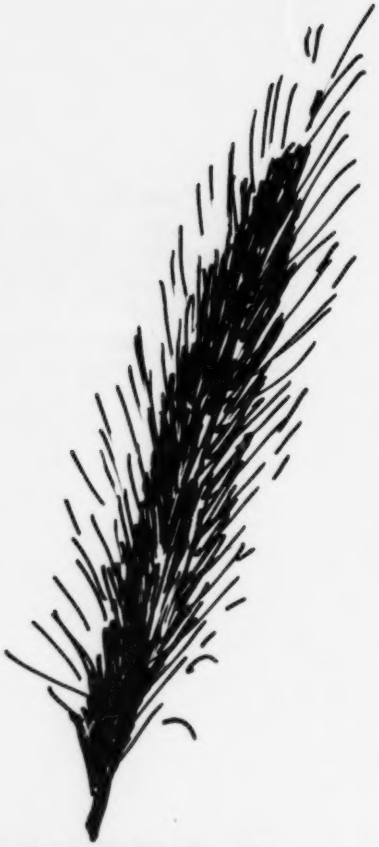
$$\frac{\text{Costs of Treatment at Denver Metro + Costs of Conveyance to Denver Metro}}{\text{Cost of Northglenn Multi-Purpose Project}} \times 1.15$$

$$\frac{5{,}095{,}000 + 5{,}434{,}000}{18{,}067{,}000} \times 1.15 = .6702$$

Item	Cost Estimate*	Eligible Fraction	75% Grant	Bonus for Alternative Technology
Treatment Lagoons	$3,450,700	(.6702)(.75)	$1,734,494	
Storage Reservoir	6,361,100	(.6702)(.85)	3,197,407	$ 426,321
Force Main	2,139,500	(.6702)(.75)	1,075,420	
Pump Station A	712,600	(.6702)(.75)	358,188	
Field Monitoring Program	77,500	(.6702)(.85)	38,955	5,194
Dacono Disinfection	32,500	(.6702)(.85)	16,336	2,178
Firestone & Frederick Tailwater Control	163,700	(.6702)(.85)	82,284	10,971
			$6,503,084	$ 445,654

TOTAL - $6,947,748 (rounded to $6,948,000)

*The actual cost will be the construction bid amount (see Appendix J for further details of these cost estimates).



CHAPTER 7

PUBLIC PARTICIPATION AND COORDINATION

"Whatever an author puts between the two covers of his book is public property; whatever of himself he does not put there is his private property, as much as if he had never written a word."

Gail Hamilton
Country Living and Country Thinking (1862)

CHAPTER 7

PUBLIC PARTICIPATION AND COORDINATION

During preparation of this document several meetings have been held to inform the public and solicit public comment. These meetings have involved the public at large, vested interest groups, and local and regional governmental entities. At the outset of the project a discussion panel was established. The panel met officially in two public meetings and other informational meetings. Participants on the advisory panel are listed below in Table 7-1. The first public meeting was held August 30, 1979 and concentrated on public health risks and direct impacts of the facilities. The second public meeting on September 13, 1979, discussed the flow augmentation plan and impacts on agriculture.

The following is a chronology of the public meetings held, and a summary of the issues discussed during these meetings.

July 19, 1979 - EPA and Weld County citizens met in Frederick, Colorado. EPA staff were shown problem areas including Dacono's reservoir tailwater flow near Frederick and asked to protect canal water quality for drinking water use. EPA has determined that it is necessary to require chlorination of Dacono's nonpotable water supply, however, the canal need not be protected as a drinking water supply source (see EPA's decision in Chapter 1).

August 15, 1979-EPA and Consolidated Ditch met in Brighton, Colorado. The meeting centered around Northglenn's preliminary flow augmentation plan, how it may effect South Platte water rights and South Platte agriculture. Key issues discussed included: tributary groundwater reductions; nitrogen concentrations; effects on sugar beets, barley, and livestock; noxious weeds; and impacts to the South Platte. These issues are discussed under "Agricultural Issues" in Chapter 4.

August 28, 1979-EPA, State Health Department and Northglenn met in Denver, Colorado. The purpose of this meeting was to discuss grant eligibility, proposed permit requirements and Northglenn's commitment to agriculture reuse. Key conclusion of this meeting was that Northglenn owns sufficient land to ensure an agricultural commitment. The issue of meeting a 200/100 ml fecal coliform limit was discussed and Northglenn has now agreed to meet this criterion(see Chapter 5 on Steps to Minimize Adverse Effects).

August 30, 1979-Citizens Discussion Panel met in Frederick, Colorado. Discussion at this meeting focused on public health and direct impacts of the facilities. It was concluded that significant public health risks are associated with the plan as proposed. A permit requirement of 200/100 ml fecal coliform would reduce health risks and provide a better degree of protection. Panel members discussed the following issues before the session was opened to questions and answers from the floor:

Issue: Northglenn expressed a fear of setting precedent which will impact all waters of the State.

Response: There are similar circumstances in the State where secondary treated effluent is used for irrigated agriculture especially when low stream conditions exist. However, under the Northglenn plan discharge of treated effluent without any dilution from another source is part of the day-to-day operational plan. EPA concludes that additional measures are necessary for this unique situation. Both EPA and the State of Colorado are considering establishing uniform permit requirements for uncontrolled agricultural reuse.

Issue: There is a lack of downstream monitoring to insure compliance.

Response: Additional monitoring will be done by Northglenn in order to understand the effects of the plant operation (See Chapter 5 on "Additional Monitoring Requirements").

Issue: Treatment process will not be able to control pathogens.

Response: Die-off of pathogens in lagoon systems is excellent. (See Literature Review of Public Health Risks in Appendix C).

Issue: Hazards associated with a treatment plant upset during peak irrigation season.

Response: Northglenn's operational plan must provide for this contingency.

Issue: Effect of nutrients on fertilizer requirements and groundwater.

Response: (See both the Agricultural Reuse Manual requirement and Additional Monitoring Requirements in Chapter 5).

Issue: Panel members expressed concern over lack of advanced information.

Response: EPA has tried to accomodate all requests for information as the information becomes available. EPA has placed all public materials concerning the Northglenn Project on reserve in EPA's library (See the Index and Reference section).

Issue: The plan degrades Bull Canal water quality thus eliminating it as a future water supply source.

Response: This is correct, see analysis on this issue in Chapter 4.

Issue: Complaint issued that treatment process operation has not been evaluated.

Response: EPA intends to complete further analysis of the treatment process during preparation of the final EIS.

Issue: Public health risks of Bull Canal tailwater in Frederick and Firestone.

Response: A tailwater control plan is required (See EPA decision in Chapter 1).

Issue: Stability and lining of Bull Canal reservoir.

Response: EPA will require additional construction measures to reduce seepage (See Chapter 5).

Questions from the floor addressed the following topics:

Issue: Does the treatment process have the ability to meet the BOD and suspended solids limit of 30-30 (BOD-SS)?

Response: Northglenn must comply with provisions under the State issued NPDES permit to meet these limits. The proposed treatment method is unique in using controls on alkalinity to meet these standards. EPA has conducted further analysis of the treatment process and concludes suspended solids concentrations could exceed permit limits. Therefore, control of algal growth may be necessary.

Issue: Can FRICO farmers be restricted in the crops they choose to grow and were cropping practices studied?

Response: Cropping practices were studied (See Agriculture in the Study Area in Appendix G). Farmers are not restricted in crop selection, however, Northglenn must advise farmers regarding raw edible crops grown with their effluent. (See Public Health Measures in Chapter 5.)

Issue: Why are there no EPA or State studies to develop viral correlations to coliform counts ?

Response: Studies on the relationships of viral concentrations to coliform bacteria have been conducted. However, present data are inconclusive to establish any meaningful correlations.

Issue: What effect will industrial wastes have on water quality and treatment processes?

Response: See discussion on Heavy Metals and Industrial Pretreatment Requirements in Chapter 4.

Issue: Is there an effect from nitrates on Ft. Lupton's future water supply?

Response: No, see Use of Canal Water for Drinking Water Supply.

Issue: Will storage eliminate virus?

Response: No, but pathogens do die-off during storage, see Appendix C.

Issue: Will quality of water restrict farmers in irrigation practices?

Response: Changes in some irrigation practices will be necessary See outline of Agricultural Reuse Manual in Chapter 5.

Issue: Northglenn will have to develop physical measures for tailwater in Frederick and Firestone and irrigation water in Dacono.

Response: Yes, see EPA's decision in Chapter 1.

Issue: Odor will create a problem in the surrounding area.

Response: Possibly, see analysis of odor problems in Chapter 4.

Issue: Treatment facility will not work as designed.

Response: See previous answer on this issue.

Issue: The potential for cross-contamination of vegetables.

Response: EPA believes the potential for cross-contamination of vegetables does not create a health risk. Vegetables irrigated with effluent are not to be sold commercially and Northglenn's operational plans require a mode for educating farmers of appropriate precautionary measures for private use.

Issue: Can Denver Metro handle Northglenn until 1985?

Response: Denver Metro must expand its facilities by 1985, see EPA funding criteria in Chapter 6.

Issue: Who is responsible for enforcement of standards?

Response: The Colorado State Health Department.

Issue: Who controls stopping discharge if water quality is not suited for agriculture?

Response: EPA and Colorado State Health Department.

Issue: Is there going to be groundwater pollution under canals?

Response: The Bull Canal will be lined by FRICO, see section on "Canal Lining" in Chapter 4.

Issue: Will EPA address potential for canals to be used as potable water supplies?

Response: EPA has determined such protection is unwarranted.

Issue: If Frederick were using the water as a domestic source would there be a different determination as to protecting this supply?

Response: Yes, if a water source is currently used for any purpose EPA is required to protect water quality for that use.

Issue: FRICO shareholders have not approved plan by a majority.

Response: The Board of FRICO has approved this plan.

Issue: The plan results in a loss of taxable income to Counties, will impact local communities and is not consistent with Weld County Land Use Plan.

Response: Tax loss is quantified in Chapter 4. The Weld County Planning Commission has approved the treatment plant site.

Issue: The plan is not consistent with 208 plans, and conflict in designating a Management Agency.

Response: See discussion on Management Agency designation in Chapter 5.

Issue: Water lost from South Platte is a concern which may be prevented if alternative water supplies besides Standley Lake are evaluated. Project should be held up until Water Court decision is made.

Response: EPA believes Water Court approval is likely with changes, see Proposed EPA Decision.

Issue: Frederick's future water supply was discussed as to how they intend to meet their requirement.

Response: EPA advises Frederick to seek an alternative water supply other than the Bull Canal.

Issue: What happens if Water Court requires more augmentation water to implement plan?

Response: Then Northglenn must secure such water flows.

Issue: What water supply alternatives were evaluated?

Response: See Water Supply Alternatives in Chapter 3.

Issue: Can the concept of the augmentation plan be approved by the Water Court?

Response: This must be resolved by the Water Court.

Issue: If groundwater is contaminated in wells near the reservoir will Northglenn provide a new water supply?

Response: If such contamination is a result of Northglenn's facility then presumably Northglenn would have to replace these wells. EPA plans to require additional construction requirements to further assure such a situation does not occur, see Additional Measures to prevent groundwater seepages in Chapter 5.

September 7, 1979 - EPA and Citizens Discussion Panel meeting in Denver, Colorado. The purpose of this meeting was to discuss with the panel issues of the plan and provide additional information to the panel members.

September 11, 1979 - EPA and State 208 coordinator meet in Loveland, Colorado. Primary discussion related to Management Agency designation, See Chapter 5.

September 13, 1979 - Citizens Discussion Panel met in Northglenn, Colorado. Discussion during this meeting focused on the flow augmentation plan and agricultural impacts. Several of the issues discussed during this meeting were identified in the first Panel meeting. The new issues and comments of this meeting are summarized below.

Issue: The flow augmentation plan appears to be viable but this determination will be made in the Water Court.

Response: Correct, see EPA evaluation regarding protection of vested water rights in Chapter 1.

Issue: There will not be any impact to sugar beets or barley in FRICO.

Response: Proper management can prevent any problem, see discussion on agriculture in Chapter 4.

Issue: Concern was expressed about basing water supply on deep wells. Can they be used only in dry years?

Response: See alternative water supply options in Chapter 3.

Issue: The plan protects agriculture, does not impact groundwater in the South Platte valley, Northglenn will develop plans to protect public health.

Response: No response necessary.

Issue: Green corn with high nitrate concentration will be toxic to cattle. How will they be protected?

Response: Proper drying of silage corn prevents this problem. See discussion on water quality in Chapter 4.

Issue: Energy may be saved by using fertilizer benefit of wastewater to reduce purchase of chemical fertilizer.

Response: Some energy costs will be reduced by recycling nutrients.

Issue: Industry will require pretreatment prior to treatment at facility.

Response: Correct, see disscusion on this issue in Chapter 4.

Issue: Advisory Panel is supposed to have technical advisory group.

Response: Not necessarily, EPA believes the Panel provided valuable recommendations which are reflected in EPA's decision.

Issue: Federal money should help provide additional storage of Colorado water.

Response: Not related to EPA mission.

Issue: Big Thompson water for Frederick is too expensive.

Response: Frederick needs to find the least-cost solution to their needs.

Issue: Agricultural impacts are - shifting agricultural water, drying up agricultural land, creating salt problem in soil, dust bowl effect, shallow wells not protected, not consistent with Governor's wishes to protect farms, noxious weeds, tax losses, nitrogen on crops, livestock and groundwater.

Response: See analysis in Chapter 4 regarding these issues.

Issue: Need another meeting to address Interagency agreements and input to consultants.

Response: EPA will require Northglenn and Weld County to execute an Intergovernmental agreement prior to grant award, See Chapter 5.

October 2, 1979 - EPA met with opponents of Plan in Loveland, Colorado. A list of requirements for the Intergovernmental agreement was presented and is discussed under the Management Agency Designation section in Chapter 5.

October 12, 1979 - EPA tours project area and meets with citizens near Frederick. Tailwater control, chlorination at Dacono and groundwater contamination were discussed. A new issue raised was whether a proposed coal strip mine by Coors would create potential for groundwater contamination. This issue will be addressed by the Office of Surface Mining, Department of Interior should Coors submit a mining plan.

TABLE 7-1

NORTHGLENN DISCUSSION PANEL

NAME	REPRESENTING
Weston Wilson	EPA, Panel Moderator
Dick Lundahl	City of Northglenn
Frank Culkins	Weisner Subdivision
Bill Schuler	Town of Frederick
Adolph Bolander	Farmers Reservoir and Irrigation Company
Elton Miller	Consolidated Ditch Company
Ray McNeil (Dick Johnson)	Denver Metro
John Hall	Weld County Health Department
John Kemp	Adams County
Bob Doyle	Denver Regional Council of Governments
John Rutstein	Larimer-Weld Council of Governments
Tess McNulty	Colorado League of Women Voters
Michael Richen (John Bermingham)	Colorado Open Space Council
Jerry Armstrong	Rocky Mountain Fuel Company

PUBLIC REVIEW OF DRAFT EIS

On January 11, 1980 EPA distributed for public review and comment the Draft Environmental Impact Statement of the Northglenn Water Management Program. A public hearing was held on February 13, 1980 to receive comments on the draft report. A summary of the public hearing, written comments received on the draft environmental impact statement, and EPA's response to the public hearing and comments are presented in Appendix A.

CHAPTER 8

LIST OF PREPARERS

CHAPTER 8

LIST OF PREPARERS

Environmental Protection Agency

Weston W. Wilson - Project Officer - Environmental Engineer

B.S. in Geological Engineering and M.S. in Water Resources Administration from the University of Arizona, Tucson, Arizona. Five years experience with EPA as project officer for environmental impact statements for wastewater treatment facilities including Steamboat Springs, Colorado, and Jackson Hole, Wyoming. Special emphasis has been on land application of effluent, investigation of water rights, protection of environmentally sensitive areas and federal-state-local government agreements. Preparation of numerous EPA reports including water quality analyses, mined land reclamation reviews, power plant sitings and dredge and fill permits. Worked as EPA's consultant for the preparation of the President's National Water Policy.

William Rothenmeyer - Sanitary Engineer

B.S. in Civil Engineering at Rensselaer Polytechnic Institute in Troy, New York. Graduate level study at University of Colorado at Denver in Civil Engineering. Three and one half years experience with EPA in Regions II and VIII involved with permits and construction grants for municipal wastewater treatment facilities.

Engineering Science

Paul N. Seeley - Project Manager - Environmental Scientist

B.A. in Environmental Biology, University of Colorado. Seven years experience in water quality monitoring, water resource planning environmental assessment, aquatic and terrestrial ecology, evaluation of land application, and impact analysis for a variety of wastewater treatment and disposal projects.

Allan L. Udin - Sanitary Engineer

B.S. and M.S. in Civil Engineering from Montana State University. Fifteen years experience in water and wastewater treatment facility planning, design, and operation. Projects have included water treatment and storage facilities, water transmission lines, water master plans, wastewater facilities plans, design of conventional and advanced wastewater treatment facilities, and plant operations consulting.

Preceding page blank

Richard L. Elton - Sanitary and Chemical Engineer

B.S. and M.S. in Chemical Engineering from University of Texas. Nine years experience in wastewater treatment facility planning, design and operation. Projects have included municipal and industrial wastewater treatment and solid waste management systems, wastewater characterization pilot - scale treatability tests, and conceptual designs of facilities.

Earnest F. Gloyna, Ph.D. - Special Consultant

Dr. Earnest F. Gloyna, P.E. is dean of the College of Engineering at the University of Texas at Austin. He holds the Joe J. King Professorship. He is a registered professional engineer in the State of Texas. He received his BS degree in civil engineering from Texas Technological College, 1946; MS degree in civil (environmental) engineering from the University of Texas at Austin, 1949; and Doctor of Engineering degree in environmental and water-resources engineering from the Johns Hopkins University, 1952. Dr. Gloyna is author of two books in the field of environmental engineering, including one on Radiological Health, editor of five books in water resources and wastewater treatment. He has chaired several major committees and panels for the U.S. National Academy of Sciences and the National Academy of Engineering, including Committee on Radioactive Waste Management, Ocean Disposal, Environmental Manpower Planning and Waste Management. In addition, he is author of 140 professional papers on industrial wastewater management, water reuse, radiation protection, environmental health engineering and engineering education. He recently served on the Executive Committee and Director of the Water Pollution Control Federation. Dr. Gloyna has served as consultant or advisor to numerous U.S. governmental agencies, cities, and industries; to the United Nations and the World Health Organization; the World Bank; and various foreign governments and cities.

Raymond L. Anderson, Ph.D. - Special Consultant

Dr. Raymond L. Anderson is a resource economist with the Economic Research Service of the U.S. Department of Agriculture working at Colorado State University, Fort Collins, Colorado. He has been extensively involved in water resource management, and economic management of irrigation systems. He has authored more than forty publications dealing with various aspects of irrigation water use and land resources.

Bishop Associates

Harold F. Bishop - President

B.S. Civil Engineering University of Utah. Responsible for investigation and design of water resource projects, including detailed investigations of water rights, irrigation requirements, design of drainage facilities and hydraulic structures, feasibility reports and flood studies. He has served as Project Engineer on numerous water rights studies and has testified as an expert witness on water matters in various water courts in Colorado and in Jefferson County District Court. Over 50 percent of his work has been with water rights and consulting services to irrigation ditch companies.

Tipton and Kalmbach

Clinton W. Mehring - President

Mr. Mehring has an M.S. in Civil Engineering University of Colorado. Project experience includes design and structural analysis of canals, dams, and tunnels, preparation of feasibility studies, designs, specifications, and supervision of construction for numerous water resource projects throughout the world.

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  - cadmium
  - lead
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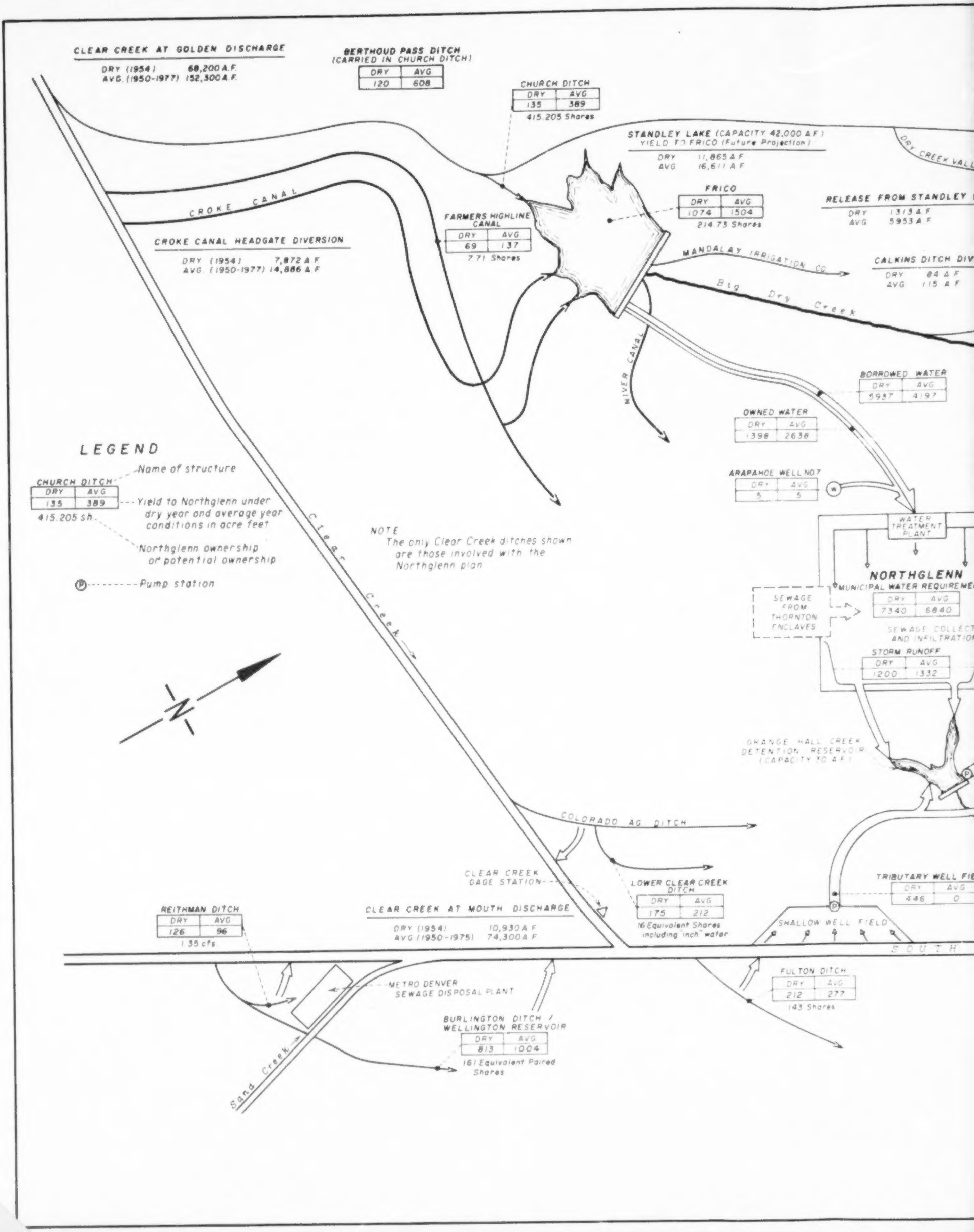
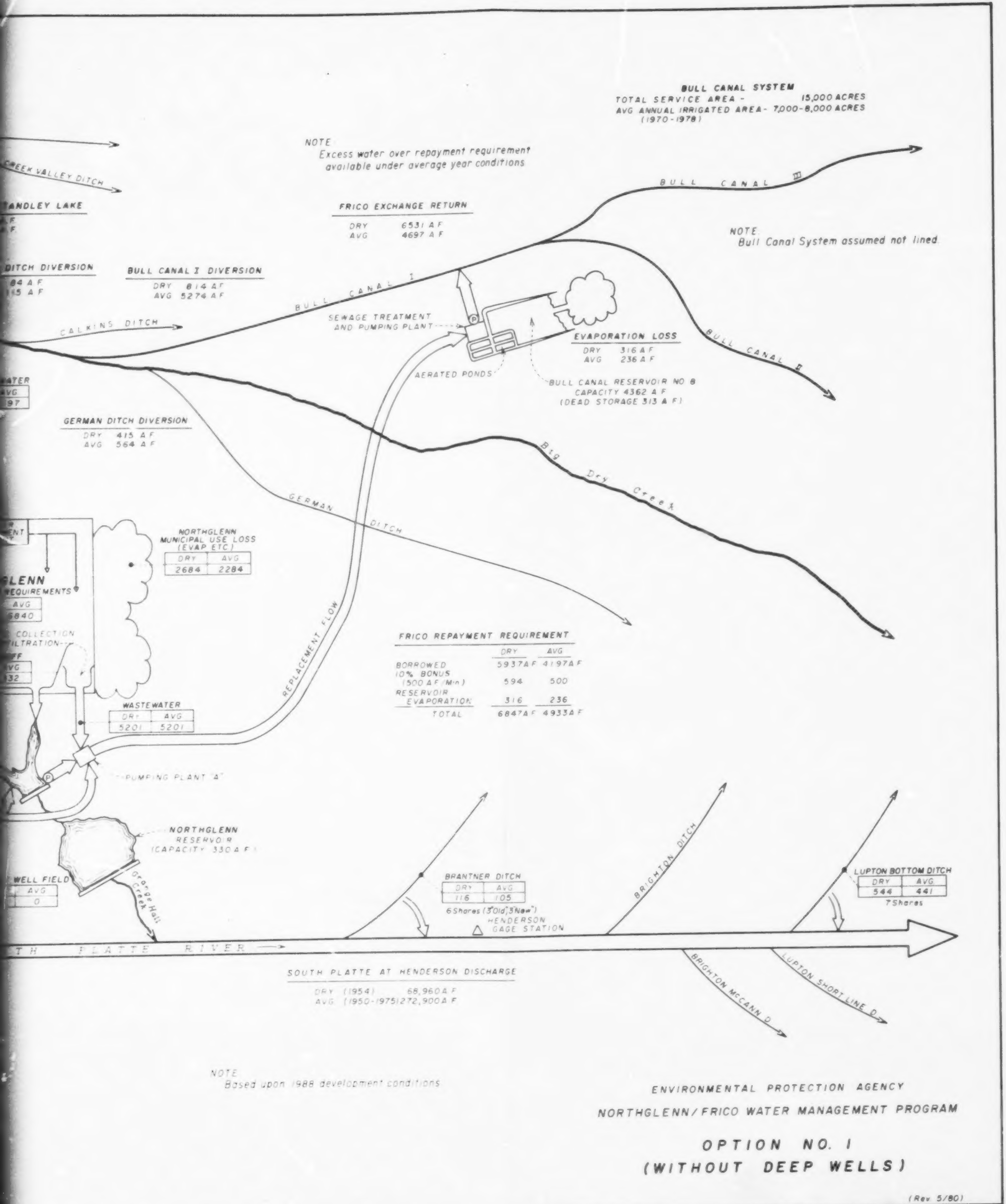

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A.F.
AVG. (1950-1977) 152,300 A.F.
BERTHOUD PASS DITCH
(CARRIED IN CHURCH DITCH)
DRY | AVG
120 | 608
CHURCH DITCH
DRY | AVG
135 | 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A.F.)
YIELD TO FRICO (Future Projection)
DRY 11,865 A.F
AVG 16,611 A.F
DRY CREEK VALL
FRICO
DRY | AVG
1074 | 1504
214.73 Shares
RELEASE FROM STANDLEY
DRY 1313 A.F
AVG 5953 A.F
CROKE CANAL
FARMERS HIGHLINE CANAL
DRY | AVG
69 | 137
7.71 Shares
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A.F
AVG. (1950-1977) 14,886 A.F
MANDALAY IRRIGATION CO
CALKINS DITCH DIV
DRY 84 A.F
AVG 115 A.F
Big Dry Creek
NIVER CANAL
BORROWED WATER
DRY | AVG
5937 | 4197
OWNED WATER
DRY | AVG
1398 | 2638
ARAPAHOE WELL NO.7
DRY | AVG
5 | 5
W
WATER TREATMENT PLANT
LEGEND
CHURCH DITCH
DRY | AVG
135 | 389
415.205 sh.
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
Northglenn ownership or potential ownership
P
Pump station
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
Clear Creek
N
NORTHGLENN
MUNICIPAL WATER REQUIREME
DRY | AVG
7340 | 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECT
AND INFILTRATIO
STORM RUNOFF
DRY | AVG
1200 | 1332
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A.F.)
P
COLORADO AG DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY | AVG
175 | 212
16 Equivalent Shares including "inch" water
TRIBUTARY WELL FIE
DRY | AVG
446 | 0
P
SHALLOW WELL FIELD
SOUTH
REITHMAN DITCH
DRY | AVG
126 | 96
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A.F
AVG (1950-1975) 74,300 A.F
METRO DENVER SEWAGE DISPOSAL PLANT
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY | AVG
813 | 1004
161 Equivalent Paired Shares
FULTON DITCH
DRY | AVG
212 | 277
143 Shares
Sand Creek

FIGURE 3-1


BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)
NOTE
Excess water over repayment requirement available under average year conditions
CREEK VALLEY DITCH
STANDLEY LAKE
DITCH DIVERSION
84 A F
115 A F
BULL CANAL I DIVERSION
DRY 814 A F
AVG 5274 A F
FRICO EXCHANGE RETURN
DRY 6531 A F
AVG 4697 A F
BULL CANAL III
NOTE
Bull Canal System assumed not lined.
BULL CANAL I
CALKINS DITCH
SEWAGE TREATMENT AND PUMPING PLANT
P
EVAPORATION LOSS
DRY 316 A F
AVG 236 A F
AERATED PONDS
BULL CANAL RESERVOIR NO 8
CAPACITY 4362 A F
(DEAD STORAGE 313 A F)
BULL CANAL II
GERMAN DITCH DIVERSION
DRY 415 A F
AVG 564 A F
Big Dry Creek
GERMAN DITCH
NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC)
DRY 2684
AVG 2284
GLENN
REQUIREMENTS
AVG 6840
COLLECTION
FILTRATION
AVG 32
REPLACEMENT FLOW
FRICO REPAYMENT REQUIREMENT
WASTEWATER
DRY 5201
AVG 5201
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A F)
WELL FIELD
AVG 0
Grange Hall Creek
BRANTNER DITCH
DRY 116
AVG 105
6 Shares (3"Old", 3"New")
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 544
AVG 441
7 Shares
SOUTH PLATTE RIVER
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F
NOTE
Based upon 1988 development conditions

FRICO REPAYMENT REQUIREMENT

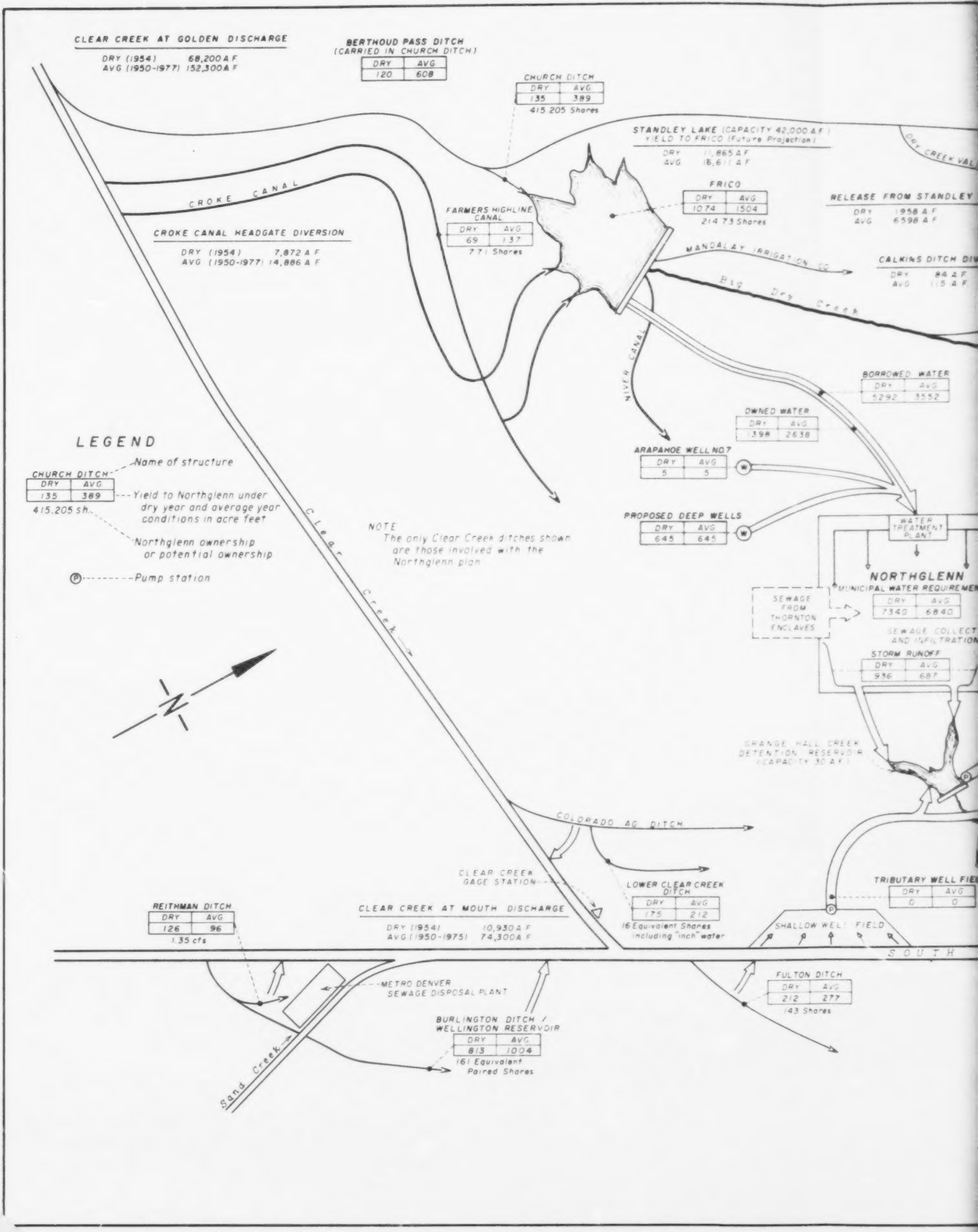
	DRY	AVG
BORROWED	5937AF	4197AF
10% BONUS (500 A F/Min)	594	500
RESERVOIR EVAPORATION	316	236
TOTAL	6847AF	4933AF

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 1
(WITHOUT DEEP WELLS)

(Rev. 5/80)


CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A F
AVG (1950-1977) 152,300 A F
BERTHOUD PASS DITCH
(CARRIED IN CHURCH DITCH)
CHURCH DITCH
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A F)
YIELD TO FRICO (Future Projection)
DRY 11,865 A F
AVG 16,611 A F
DRY CREEK VAL
FRICO
214 73 Shares
RELEASE FROM STANDLEY
DRY 1958 A F
AVG 6598 A F
CROKE CANAL
FARMERS HIGHLINE CANAL
771 Shares
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A F
AVG (1950-1977) 14,886 A F
MANDALAY IRRIGATION CO
CALKINS DITCH DIV
DRY 84 A F
AVG 115 A F
Big Dry Creek
NIVER CANAL
BORROWED WATER
OWNED WATER
ARAPAHOE WELL NO.7
PROPOSED DEEP WELLS
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMEN
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECT
AND INFILTRATION
STORM RUNOFF
GRANGE HALL CREEK
DETENTION RESERVOIR
(CAPACITY 30 A F)
LEGEND
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
415.205 sh.
Northglenn ownership or potential ownership
P
Pump station
N
Clear Creek
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
COLORADO AG DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
16 Equivalent Shares including "inch" water
TRIBUTARY WELL FIE
SHALLOW WELL FIELD
P
SOUTH
REITHMAN DITCH
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A F
AVG (1950-1975) 74,300 A F
METRO DENVER SEWAGE DISPOSAL PLANT
FULTON DITCH
143 Shares
BURLINGTON DITCH / WELLINGTON RESERVOIR
161 Equivalent Paired Shares
Sand Creek

BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)

DRY	AVG
120	608

CHURCH DITCH

DRY	AVG
135	389

415.205 Shares

FRICO

DRY	AVG
1074	1504

214 73 Shares

FARMERS HIGHLINE CANAL

DRY	AVG
69	137

771 Shares

BORROWED WATER

DRY	AVG
5292	3552

OWNED WATER

DRY	AVG
1398	2638

ARAPAHOE WELL NO.7

DRY	AVG
5	5

PROPOSED DEEP WELLS

DRY	AVG
645	645

NORTHGLENN MUNICIPAL WATER REQUIREMEN

DRY	AVG
7340	6840

STORM RUNOFF

DRY	AVG
936	687

LEGEND — CHURCH DITCH

DRY	AVG
135	389

415.205 sh.

LOWER CLEAR CREEK DITCH

DRY	AVG
175	212

16 Equivalent Shares including "inch" water

TRIBUTARY WELL FIE

DRY	AVG
0	0

REITHMAN DITCH

DRY	AVG
126	96

1.35 cfs

FULTON DITCH

DRY	AVG
212	277

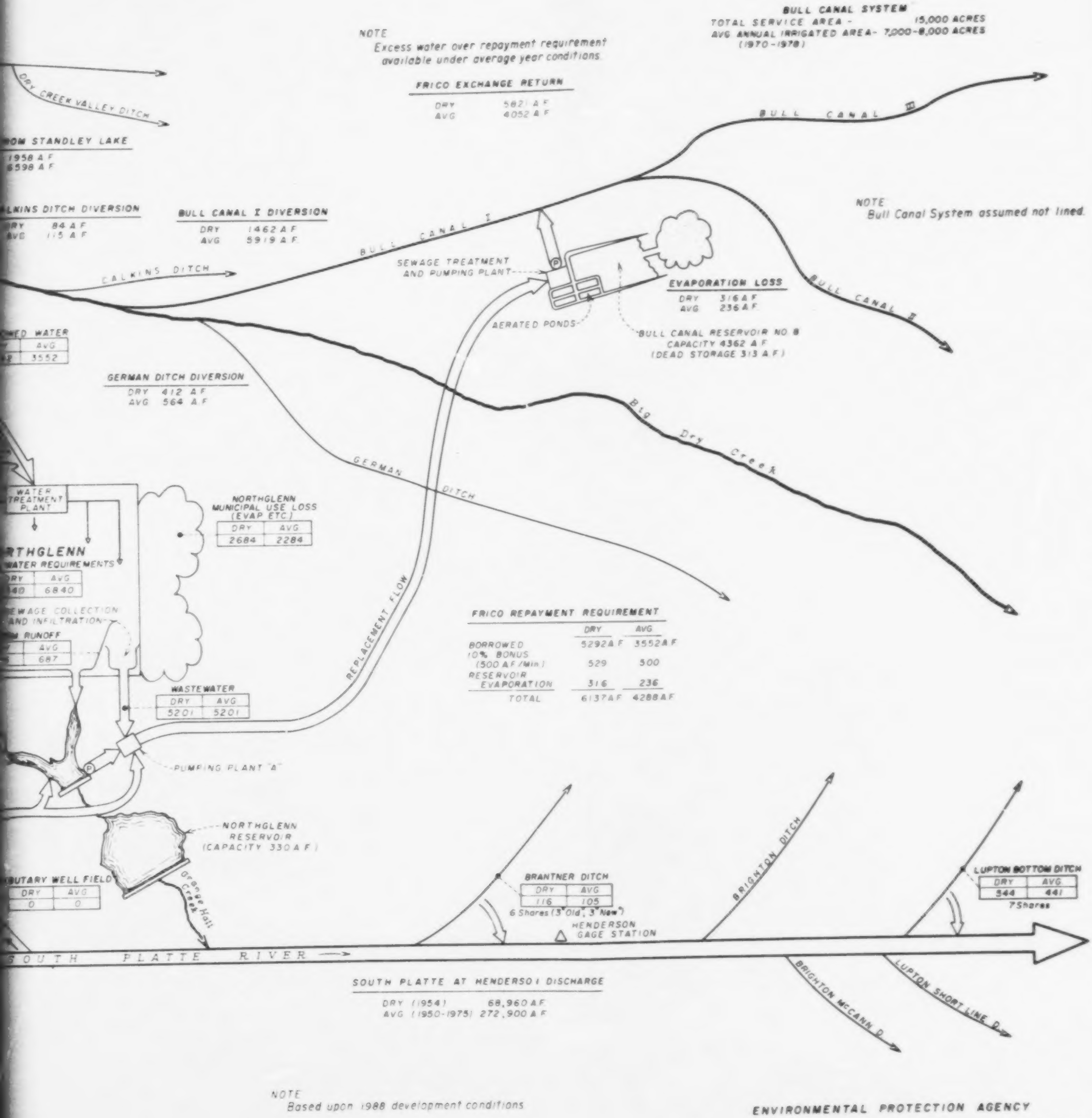
143 Shares

BURLINGTON DITCH / WELLINGTON RESERVOIR

DRY	AVG
813	1004

161 Equivalent Paired Shares

FIGURE 3-2



NOTE
Excess water over repayment requirement available under average year conditions
FRICO EXCHANGE RETURN
DRY 5821 A.F.
AVG 4052 A.F.
BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)
DRY CREEK VALLEY DITCH
OM STANDLEY LAKE
1958 A.F.
6598 A.F.
BULL CANAL
BULL CANAL III
NOTE
Bull Canal System assumed not lined.
LKINS DITCH DIVERSION
RY 84 A.F.
VG 115 A.F.
BULL CANAL I DIVERSION
DRY 1462 A.F.
AVG 5919 A.F.
BULL CANAL I
CALKINS DITCH
SEWAGE TREATMENT AND PUMPING PLANT
P
EVAPORATION LOSS
DRY 316 A.F.
AVG 236 A.F.
BULL CANAL II
AERATED PONDS
BULL CANAL RESERVOIR NO. 8
CAPACITY 4362 A.F.
(DEAD STORAGE 313 A.F.)
HED WATER
AVG
3552
GERMAN DITCH DIVERSION
DRY 412 A.F.
AVG 564 A.F.
Big Dry Creek
GERMAN DITCH
WATER TREATMENT PLANT
NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC.)
DRY 2684
AVG 2284
RTHGLENN
WATER REQUIREMENTS
RY 40
AVG 6840
EWAGE COLLECTION AND INFILTRATION
RUNOFF
AVG 687
REPLACEMENT FLOW
WASTEWATER
DRY 5201
AVG 5201
P
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A.F.)
BUTARY WELL FIELD
DRY 0
AVG 0
Grange Hall Creek
BRANTNER DITCH
DRY 116
AVG 105
6 Shares (3 Old, 3 New)
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 544
AVG 441
7 Shares
SOUTH PLATTE RIVER
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A.F.
AVG (1950-1975) 272,900 A.F.
NOTE
Based upon 1988 development conditions

FRICO REPAYMENT REQUIREMENT

	DRY	AVG
BORROWED	5292 A.F.	3552 A.F.
10% BONUS (500 A.F./Min.)	529	500
RESERVOIR EVAPORATION	316	236
TOTAL	6137 A.F.	4288 A.F.

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 2
(650 A.F. FROM DEEP WELLS)

(Rev. 5/80)

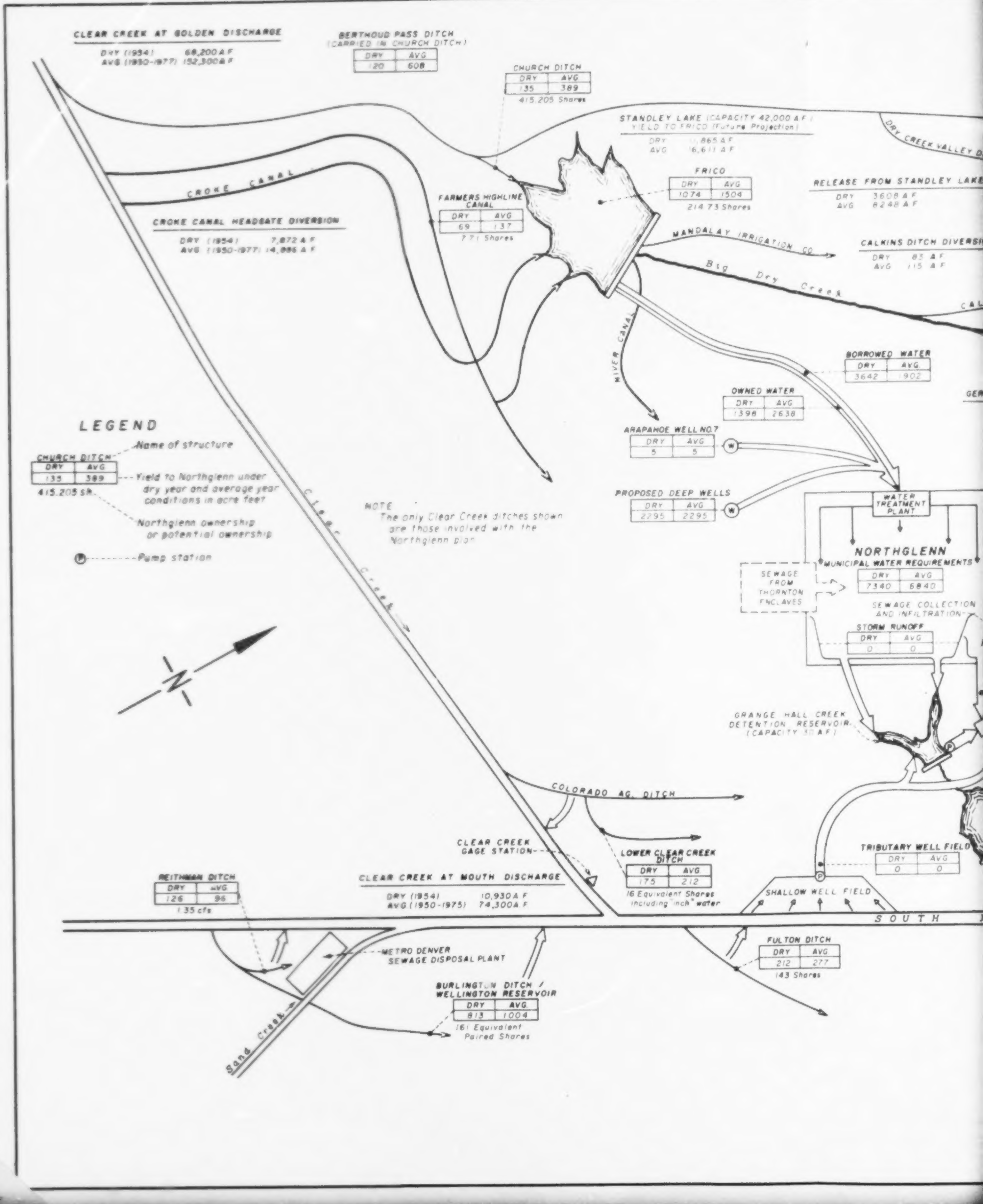
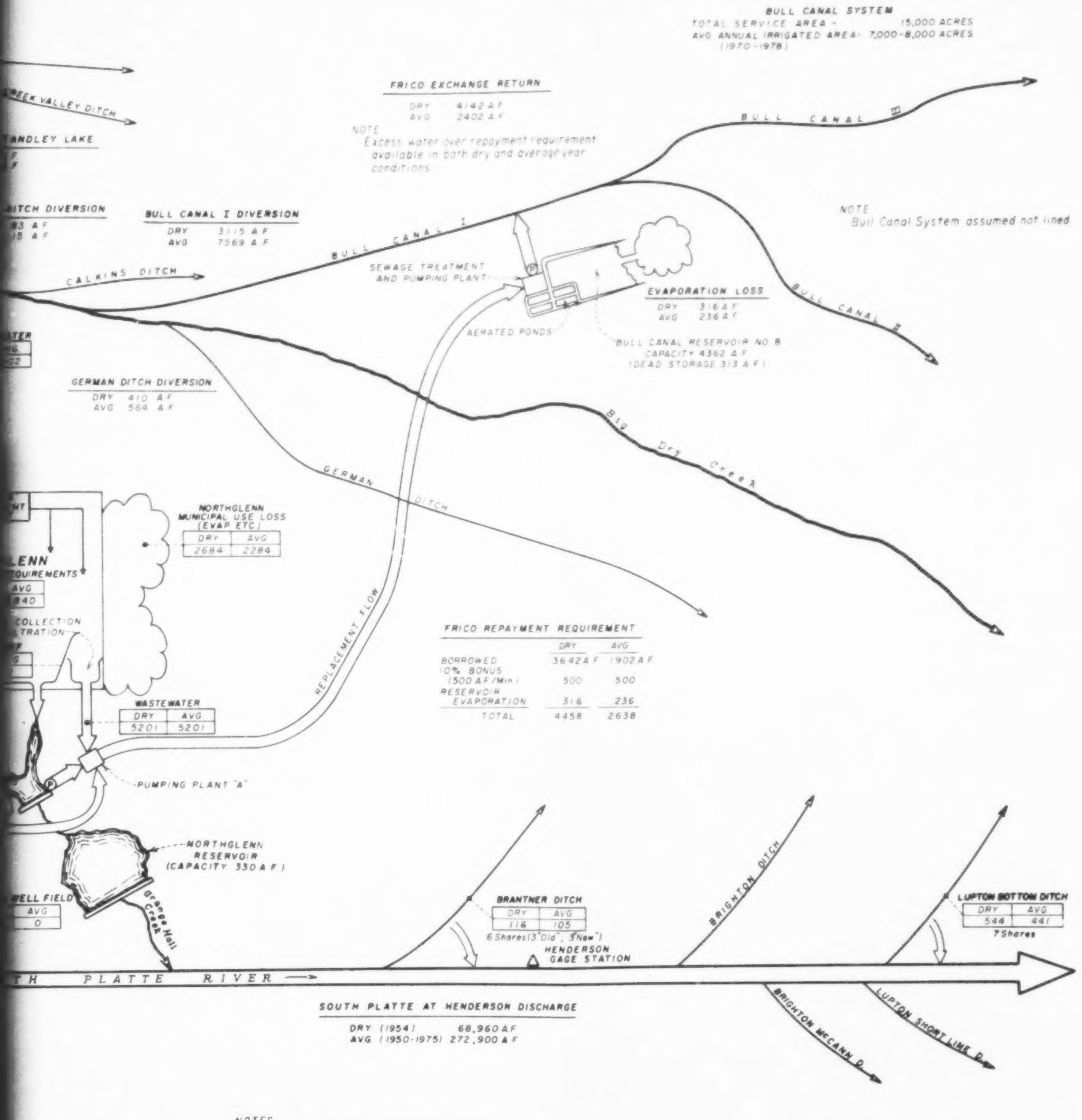

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A F
AVG (1950-1977) 152,300 A F
BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)
DRY AVG
120 608
CHURCH DITCH
DRY AVG
135 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A F) YIELD TO FRICO (Future Projection)
DRY 11,865 A F
AVG 16,611 A F
DRY CREEK VALLEY D
FRICO
DRY AVG
1074 1504
214.73 Shares
RELEASE FROM STANDLEY LAKE
DRY 3608 A F
AVG 8248 A F
CROKE CANAL
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A F
AVG (1950-1977) 14,886 A F
FARMERS HIGHLINE CANAL
DRY AVG
69 137
7.71 Shares
MANDALAY IRRIGATION CO
Big Dry Creek
CALKINS DITCH DIVERSI
DRY 83 A F
AVG 115 A F
CAL
RIVER CANAL
BORROWED WATER
DRY AVG
3642 1902
OWNED WATER
DRY AVG
1398 2638
GER
ARAPAHOE WELL NO.7
DRY AVG
5 5
PROPOSED DEEP WELLS
DRY AVG
2295 2295
W
LEGEND
CHURCH DITCH — Name of structure
DRY AVG
135 389 — Yield to Northglenn under dry year and average year conditions in acre feet
415.205 sh. — Northglenn ownership or potential ownership
P — Pump station
Clear Creek
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
N
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY AVG
7340 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
STORM RUNOFF
DRY AVG
0 0
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A F)
COLORADO AG. DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY AVG
175 212
16 Equivalent Shares including "inch" water
TRIBUTARY WELL FIELD
DRY AVG
0 0
SHALLOW WELL FIELD
P
REITHMAN DITCH
DRY AVG
126 96
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A F
AVG (1950-1975) 74,300 A F
SOUTH
METRO DENVER SEWAGE DISPOSAL PLANT
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY AVG
813 1004
161 Equivalent Paired Shares
FULTON DITCH
DRY AVG
212 277
143 Shares
Sand Creek

FIGURE 3-3


BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)
FRICO EXCHANGE RETURN
DRY 4142 A F
AVG 2402 A F
NOTE
Excess water over repayment requirement available in both dry and average year conditions
BULL CANAL III
REEK VALLEY DITCH
TANDLEY LAKE
F
F
ITCH DIVERSION
83 A F
18 A F
BULL CANAL I DIVERSION
DRY 3115 A F
AVG 7569 A F
BULL CANAL I
NOTE
Bull Canal System assumed not lined
CALKINS DITCH
SEWAGE TREATMENT AND PUMPING PLANT
EVAPORATION LOSS
DRY 316 A F
AVG 236 A F
BULL CANAL II
AERATED PONDS
BULL CANAL RESERVOIR NO 8
CAPACITY 4362 A F
(DEAD STORAGE 313 A F)
ATER
VG.
32
GERMAN DITCH DIVERSION
DRY 410 A F
AVG 564 A F
Big Dry Creek
GERMAN DITCH
NT
NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC)
DRY | AVG
2684 | 2284
LENN
QUIREMENTS
AVG
940
COLLECTION
TRATION
6
REPLACEMENT FLOW
FRICO REPAYMENT REQUIREMENT
DRY | AVG
BORROWED 3642 A F | 1902 A F
10% BONUS (500 A F/Min) 500 | 500
RESERVOIR EVAPORATION 316 | 236
TOTAL 4458 | 2638
WASTEWATER
DRY | AVG
5201 | 5201
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A F)
WELL FIELD
AVG
0
Grange Hall Creek
BRANTNER DITCH
DRY | AVG
116 | 105
6 Shares (3 "Old", 3 "New")
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY | AVG
544 | 441
7 Shares
TH PLATTE RIVER ⟶
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F
BRIGHTON McCANN D.
LUPTON SHORT LINE D.

NOTES
Based upon 1988 development conditions
Augmentation of replacement water not required under this option

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 3
(2300 A.F. FROM DEEP WELLS)

(Rev. 5/80)

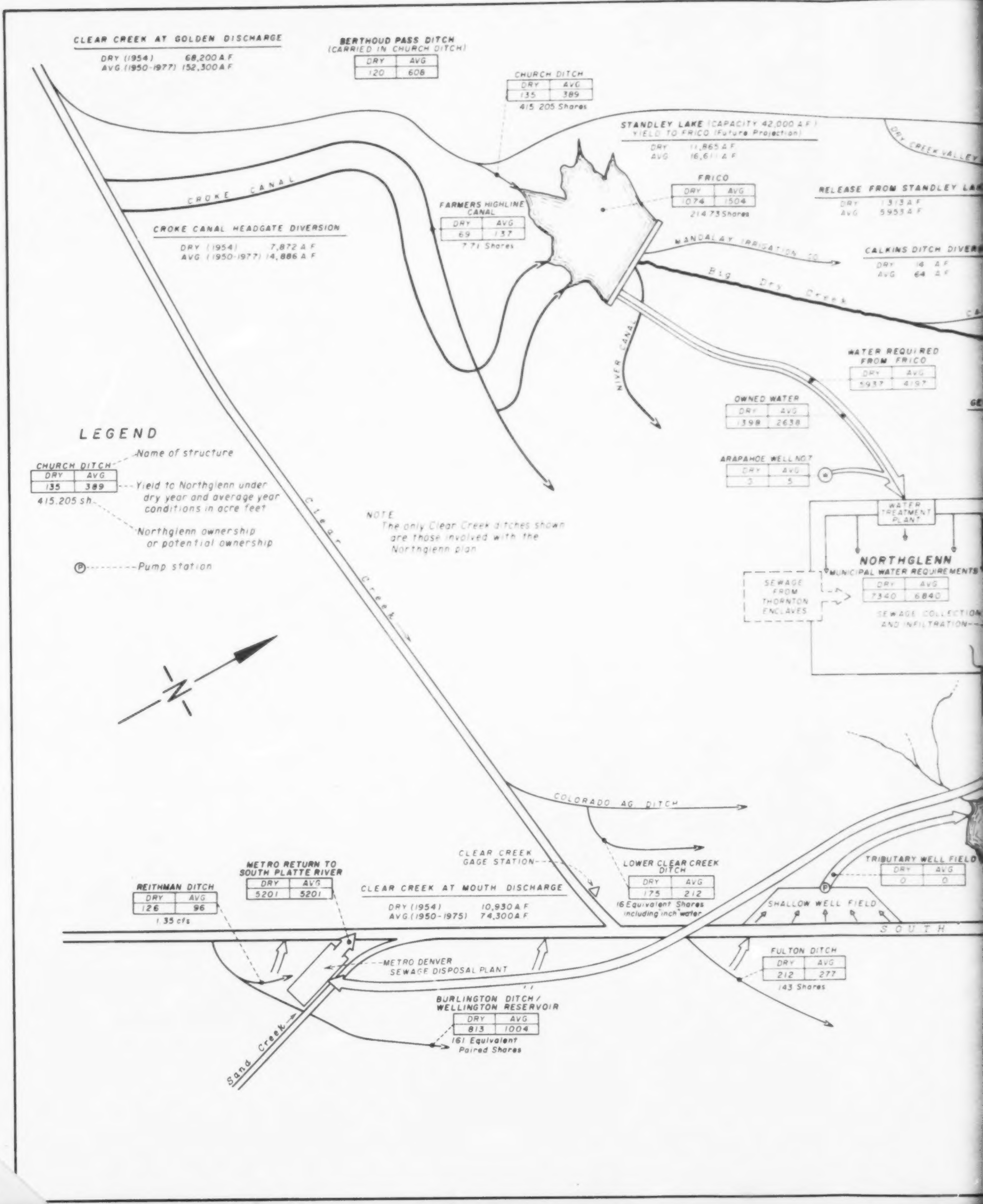
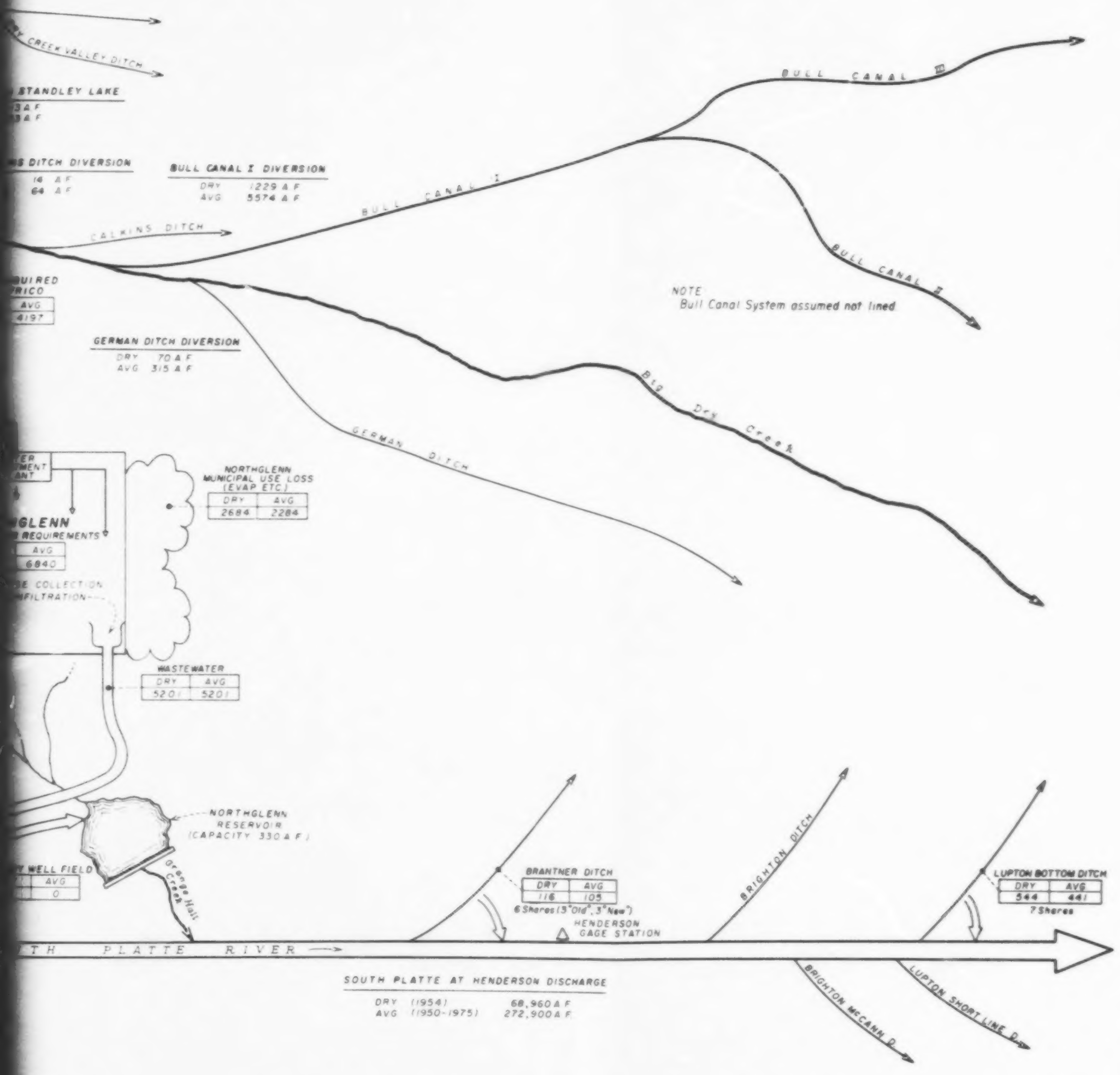

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A.F.
AVG.(1950-1977) 152,300 A.F.
BERTHOUD PASS DITCH
(CARRIED IN CHURCH DITCH)
DRY 120
AVG 608
CHURCH DITCH
DRY 135
AVG 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A.F.)
YIELD TO FRICO (Future Projection)
DRY 11,865 A.F.
AVG 16,611 A.F.
DRY CREEK VALLEY
FRICO
DRY 1074
AVG 1504
214.73 Shares
RELEASE FROM STANDLEY LA
DRY 1313 A.F.
AVG 5953 A.F.
CROKE CANAL
FARMERS HIGHLINE CANAL
DRY 69
AVG 137
7.71 Shares
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A.F.
AVG. (1950-1977) 14,886 A.F.
MANDALAY IRRIGATION CO.
CALKINS DITCH DIVER
DRY 14 A.F.
AVG 64 A.F.
Big Dry Creek
CA
NIVER CANAL
WATER REQUIRED FROM FRICO
DRY 5937
AVG 4197
GE
OWNED WATER
DRY 1398
AVG 2638
ARAPAHOE WELL NO.7
DRY 3
AVG 5
LEGEND
CHURCH DITCH
DRY 135
AVG. 389
415.205 sh.
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
Northglenn ownership or potential ownership
P
Pump station
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
Clear Creek
N
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY 7340
AVG 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
COLORADO AG DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY 175
AVG 212
16 Equivalent Shares including "inch" water
TRIBUTARY WELL FIELD
DRY 0
AVG 0
P
SHALLOW WELL FIELD
SOUTH
METRO RETURN TO SOUTH PLATTE RIVER
DRY 5201
AVG 5201
REITHMAN DITCH
DRY 126
AVG 96
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A.F.
AVG.(1950-1975) 74,300 A.F.
METRO DENVER SEWAGE DISPOSAL PLANT
FULTON DITCH
DRY 212
AVG 277
143 Shares
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY 813
AVG 1004
161 Equivalent Paired Shares
Sand Creek

FIGURE 3-4


Y CREEK VALLEY DITCH
STANDLEY LAKE
3 A F
3 A F
S DITCH DIVERSION
14 A F
64 A F
BULL CANAL I DIVERSION
DRY 1229 A F
AVG 5574 A F
BULL CANAL III
BULL CANAL I
CALKINS DITCH
BULL CANAL II
NOTE
Bull Canal System assumed not lined
UIRED
RICO
AVG
4197
GERMAN DITCH DIVERSION
DRY 70 A F
AVG 315 A F
Big Dry Creek
GERMAN DITCH
TER
MENT
ANT
NORTHGLENN
MUNICIPAL USE LOSS
(EVAP ETC.)
DRY 2684
AVG 2284
GLENN
R REQUIREMENTS
AVG
6840
E COLLECTION
NFILTRATION
WASTEWATER
DRY 5201
AVG 5201
NORTHGLENN
RESERVOIR
(CAPACITY 330 A F)
Y WELL FIELD
AVG
0
Grange Hall Creek
BRANTNER DITCH
DRY 116
AVG 105
6 Shares (3 "Old", 3 "New")
HENDERSON
GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 544
AVG 441
7 Shares
TH PLATTE RIVER
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F
BRIGHTON MCCANN D.
LUPTON SHORT LINE D.

NOTES:
Based upon 1988 development conditions.
Augmentation of replacement water not required under this option.

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 4
(RETURN TO METRO)

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(Rev. 3/80)